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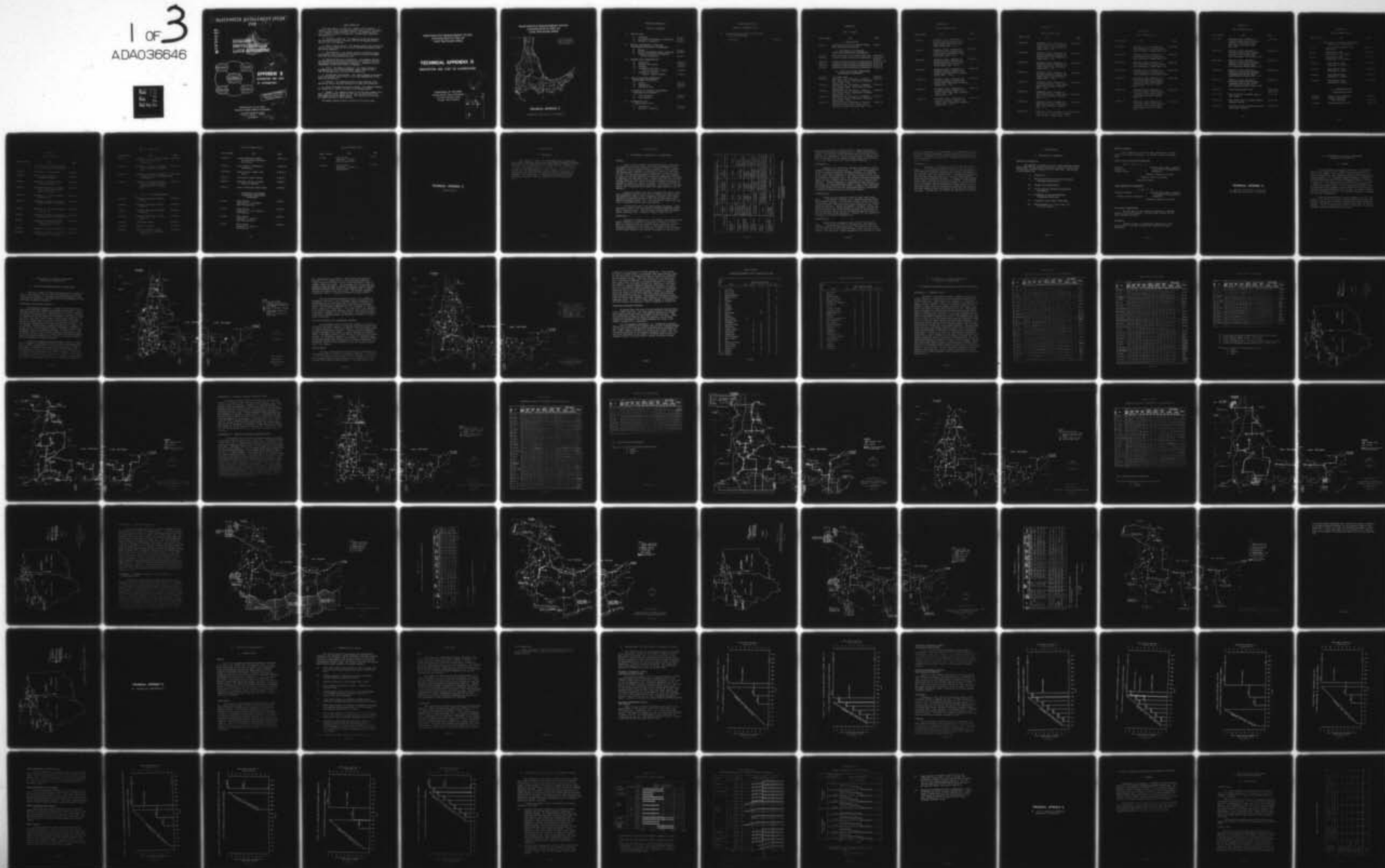
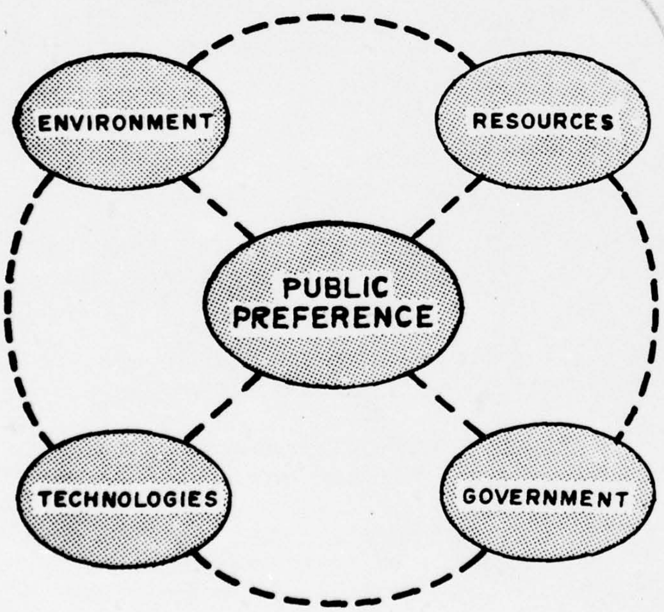


WASTEWATER MANAGEMENT STUDY FOR

CHICAGO – SOUTH END of LAKE MICHIGAN



APPENDIX D

DESCRIPTION AND COST OF ALTERNATIVES

DEPARTMENT OF THE ARMY
CHICAGO DISTRICT CORPS OF ENGINEERS
219 SOUTH DEARBORN STREET
CHICAGO, ILLINOIS 60604

JULY 1973

299p.

REPORT COMPOSITION

The survey report is divided into a Summary, and 9 Appendices. A charge for each appendix and summary report to cover the cost of printing will be required, should purchase be desired. The appendices each contain a different category of information. Alphabetically identified, the appendices are:

A. Background Information - This appendix includes the population and industrial projections, wastewater flows and the engineering data used as a basis for planning.

B. Basis of Design and Cost - This appendix contains the criteria and rationale used to design and cost the final alternative wastewater treatment system components.

C. Plan Formulation - The appendix presents the planning concepts and procedures used in developing the alternative wastewater management plans that were examined during the study.

D. Description and Cost of Alternatives - This appendix contains a cost description and construction phasing analysis for each of the final five regional wastewater management alternatives. Components of these alternatives are described in detail in Appendix B.

E. Social - Environmental Evaluation - This report provides an assessment of the social and environmental impacts likely to arise from the implementation of the final five alternatives.

F. Institutional Considerations - This report presents an assessment of the institutional impacts likely to arise from implementation of the final five alternatives.

G. Valuation - This appendix presents a broad evaluation of the implications and use potential inherent in the final five alternatives.

H. Public Involvement/Participation Program - This appendix documents the program used to involve the public in the planning process.

I. Comments - This appendix contains all of the formal comments from local, State and Federal entities as the result of their review of the other appendices and the Summary Report. Also capsulized are the views of citizens presented at public meetings.

The Summary document presents an overview of the entire study.

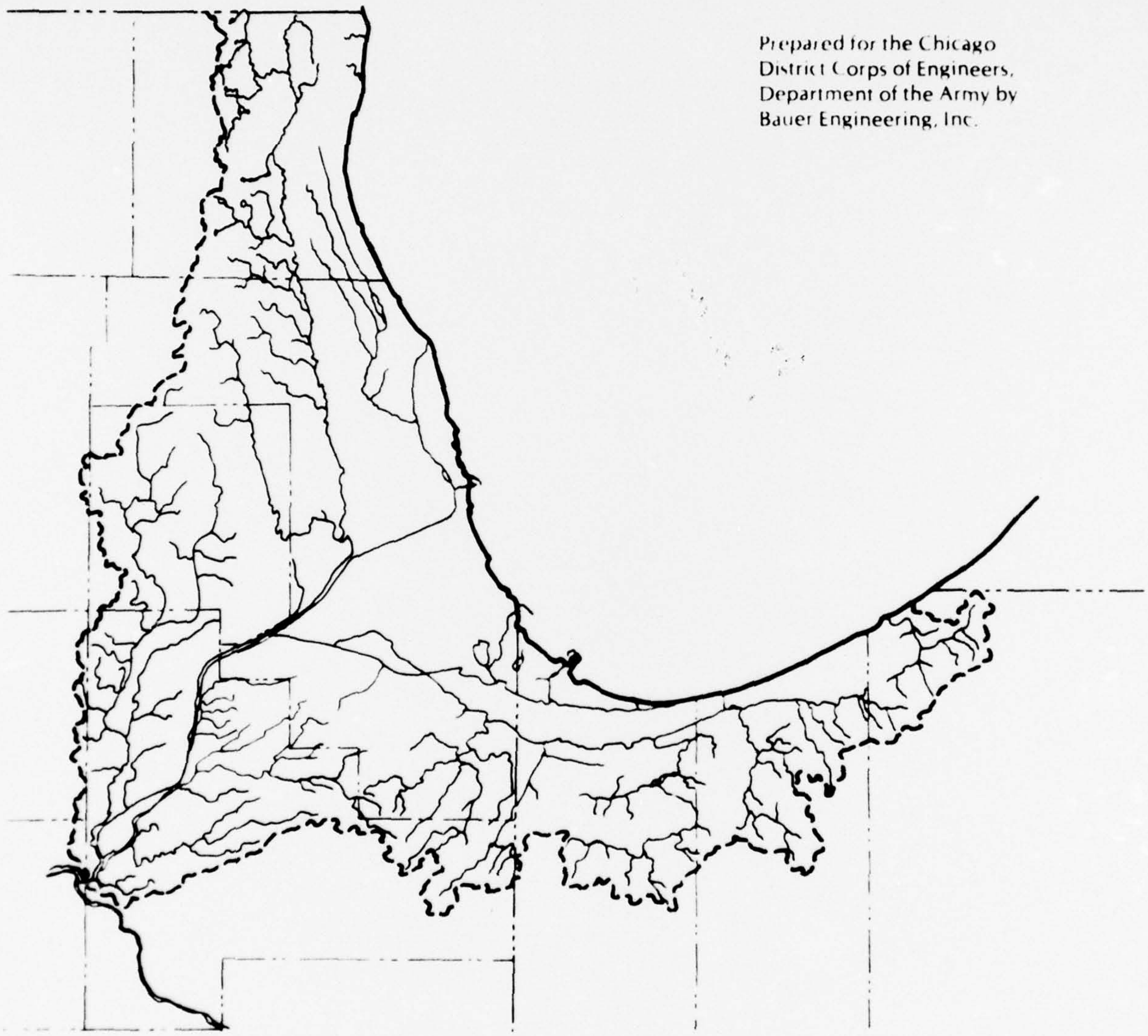
WASTEWATER MANAGEMENT STUDY
CHICAGO-SOUTH END OF LAKE MICHIGAN AREA

TECHNICAL APPENDIX D

DESCRIPTION AND COST OF ALTERNATIVES

DEPARTMENT OF THE ARMY
Chicago District, Corps Of Engineers
219 South Dearborn Street
Chicago, Illinois 60604

WASTEWATER MANAGEMENT STUDY
CHICAGO-SOUTH END OF LAKE MICHIGAN AREA



Prepared for the Chicago District Corps of Engineers, Department of the Army by Bauer Engineering, Inc.

TECHNICAL APPENDIX D

DESCRIPTION AND COST OF ALTERNATIVES

TECHNICAL APPENDIX D

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APPENDIX D

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TECHNICAL APPENDIX D

I. INTRODUCTION

I. INTRODUCTION

A. ORIENTATION

This volume is a part of the United States Army, Chicago District, Corps of Engineers, Survey Scope Study Report for Regional Wastewater Management in the Chicago-South End of Lake Michigan (C-SELM) area. The overall Survey Scope Study report consists of a summary volume and a number of supporting appendices. This appendix, Appendix D, Description and Cost of Alternatives, contains a detailed description and cost analysis for each of the five regional wastewater management alternatives. Each alternative is constructed from management system components described in detail in Appendix B, Basis of Design and Cost.

I. INTRODUCTION

B. NON-SPECIFIC DESCRIPTION OF ALTERNATIVES

GENERAL

Each of the five regional wastewater management alternatives is constructed by placing together the individual management system components which are fully described in Appendix B. After a detailed description of each alternative is presented in Section II, a phasing and implementation schedule for each alternative is considered in Section III. The component management system unit costs from Appendix B, Section VI are then aggregated over planned implementation schedules to determine total alternative costs. Present worth costs and the annual average charge for each regional wastewater management alternative are presented in Section IV. Section V presents a comparison between the regional wastewater management alternatives. This includes a cost comparison and a comparison of the stream flow regime impact for each alternative.

Section VI compares the current alternatives for regional wastewater management with the results of the C-SELM Model Study which was published by Office, Chief of Engineers, under the title "Regional Wastewater Management Systems for the Chicago Metropolitan Area", Technical Appendix, March, 1972. The final section, Section VII, presents a recommendation for future pilot programs.

To place the reader in the proper reference framework, a brief description of each of the five regional wastewater management alternatives is presented below. This description includes major management system components only. Reference is made to Table D-I-B-1.

ALTERNATIVE I

Alternative I, Reference Plan, is designed to meet current stream quality standards as identified by the States of Illinois and Indiana. Sixty-four treatment plants are projected for this alternative, which reflect the regional plans of the various C-SELM planning agencies. Stormwater management for this alternative is limited to the incorporation of the Chicago Underflow Plan plus the management of flows from the

COMPONENT	REGIONAL WASTEWATER MANAGEMENT ALTERNATIVE				
	I	II	III	IV	V
	Reference Plan	Physical-Chemical	Advanced Biological	Land Treatment	Combination
TREATMENT SYSTEM	Existing Standards	NDCP	NDCP	NDCP	NDCP
CONVEYANCE SYSTEM	Underflow Plan Conveyance & Combined Sewer Area	64 to 33 Plant	64 to 17 Plant	64 to Land Sites	64 to 5 Regional Plants & Land Sites
STORMWATER MANAGEMENT SYSTEM	Urban Underflow Plan & Combined Sewer Areas	Complete Urban Suburban Rural	Complete Urban Suburban Rural	Complete Urban Suburban Rural	Complete Urban Suburban Rural
SLUDGE MANAGEMENT SYSTEM	Agricultural Utilization	Agricultural Utilization	Agricultural Utilization or Land Reclamation	Agricultural Utilization or Land Reclamation	Agricultural Utilization or Land Reclamation
REUSE SYSTEM	None	Potable and Recreational-Navigational	Potable and Recreational-Navigational	Potable and Recreational-Navigational	Potable and Recreational-Navigational
ROCK & SOIL MANAGEMENT SYSTEM	Limited to Underflow Plan	Complete	Complete	Complete	Complete

Table D-I-B-1

DESCRIPTIVE INFORMATION ON REGIONAL WASTEWATER MANAGEMENT ALTERNATIVES

remaining areas served by combined sewers. Sludge management is accomplished through the implementation of an agricultural utilization program. The 64 plants in this alternative serve as the base for different regional aggregations, acting as access points or treatment facilities for treatment plant and combined treatment plant-land alternatives or as access points only for the land treatment alternative.

ALTERNATIVE II

Alternative II is designed to meet the no discharge of critical pollutants (NDCP) water quality goals. The alternative provides for 33 physical-chemical technology treatment facilities. A conveyance system is provided to aggregate the existing 64 treatment plants into the 33 plants, with the phased out plant sites serving as access points for municipal and industrial flows. The complete stormwater management system for urban, suburban and rural land-use areas is applied to this alternative. Sludge management is accomplished through agricultural utilization. The reuse management system for both potable options and the recreational-navigational reuse option is applied to this alternative. A complete residual rock and soil management program is implemented to provide the orderly removal and use of this material.

ALTERNATIVE III

Alternative III is designed to meet the NDCP water quality goals. The alternative provides for 17 advanced-biological technology treatment facilities. The conveyance system conveys flows from 47 base plant sites which now act as access points to the 17 regional treatment facilities. Stormwater management encompasses urban, suburban and rural flows. Sludge management is provided, with both agricultural utilization and land reclamation evaluated for this alternative. Both potable reuse options and the recreational-navigational reuse system are evaluated for this alternative. Complete rock and residual soil management is provided for Alternative III.

ALTERNATIVE IV

Alternative IV is designed to meet the NDCP water quality goals. The alternative uses five dispersed land sites which provide land treatment for wastewater flows. Conveyance tunnels transmit flows from the 64 former treatment plants, which now act as access points, to the land sites. Sludge management is accomplished by either

agricultural utilization or land reclamation. Both potable reuse options and the recreational-navigational reuse system are provided for this alternative. In addition, the reuse system includes return conveyance from the land sites to the sudy area. Complete rock and soil management is provided.

ALTERNATIVE V

Alternative V is designed to meet the NDCP water quality goals. The alternative provides treatment through five regional advanced biological treatment plants in the inner, more urbanized area, and a number of dispersed, land sites which provide land treatment, and serve the outer, more suburban area. Conveyance transports flows from the former treatment plant sites to the five regional treatment plants and to the dispersed land sites. Complete stormwater management of urban, suburban and rural flows is provided. Sludge management is provided by either agricultural utilization or land reclamation. Reuse of reclaimed water is accomplished through either of the potable reuse options, and the recreational-navigational reuse provision. The reuse system provides for the return of flows from the land treatment area. Complete rock and residual soil management is provided.

I. INTRODUCTION

C. STRUCTURE OF APPENDIX D

APPENDIX ORGANIZATION

The Appendix is divided into seven, roman-numeraled sections which outline the five regional alternatives and their associated costs and presents a detailed comparison of all alternatives. The sections in this appendix are: CONTENTS:

I. Introduction

II. Specific Description of Regional Wastewater Management Alternatives;

III. Phasing and Implementation;

IV. Cost of Regional Wastewater Management Alternatives;

V. Comparison of Regional Wastewater Management Alternatives;

VI. Comparison with C-SELM Model Study, and

VII. Recommendations for Future Studies and and Pilot Programs.

APPENDIX LABELING

Page numbering and Figure and Table identification are referenced by a four place designation. An example of each is presented below:

Table or Figure Labeling and Referencing

Table or Figure D - IV - A - 3

Identifies reference as a table or figure

Identifies table number, numbered consecutively from beginning of subsection.

Identifies subsection of section

Identifies section of appendix

Identifies Appendix

Page Numbering and Referencing

D - VII - D - 14

Identifies Appendix

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Identifies section of Appendix

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DATA ANNEX ORGANIZATION

The data annex to this appendix is organized in a parallel structure to the formal appendix. The data annex contains more detailed supporting information.

REFERENCES

Reference numbers for bibliographic references are listed chronologically at the end of appendix and appendix data annex subsections.

TECHNICAL APPENDIX D

II. SPECIFIC DESCRIPTION OF REGIONAL WASTEWATER MANAGEMENT ALTERNATIVES

II. DESCRIPTION OF REGIONAL WASTEWATER MANAGEMENT ALTERNATIVES

A. GENERAL

The five wastewater management alternatives, which are examined in this appendix for the C-SELM study area are described in detail in this section. The description of these alternatives is presented by detailing the basic components which comprise regional wastewater management, i.e., treatment, sludge, stormwater, conveyance, reclaimed water reuse and rock spoil management systems. The basis of design and cost for these systems is presented on a unit cost basis in Appendix B. Also presented in Appendix B are non-structural and synergism management systems. The non-structural management system is not included in this appendix since no direct costs are associated with this component together with the fact that it is common to all five alternative management systems. The synergism component is presented and examined in Appendix G.

Graphical representations of the five alternatives are also presented in this section which include treatment facility and access point locations, service area boundaries, wastewater and sludge conveyance systems, land treatment and sludge utilization areas and water balance diagrams. Finally, a descriptive table for each alternative is presented including pertinent treatment facility information.

II. DESCRIPTION OF REGIONAL WASTEWATER MANAGEMENT ALTERNATIVES

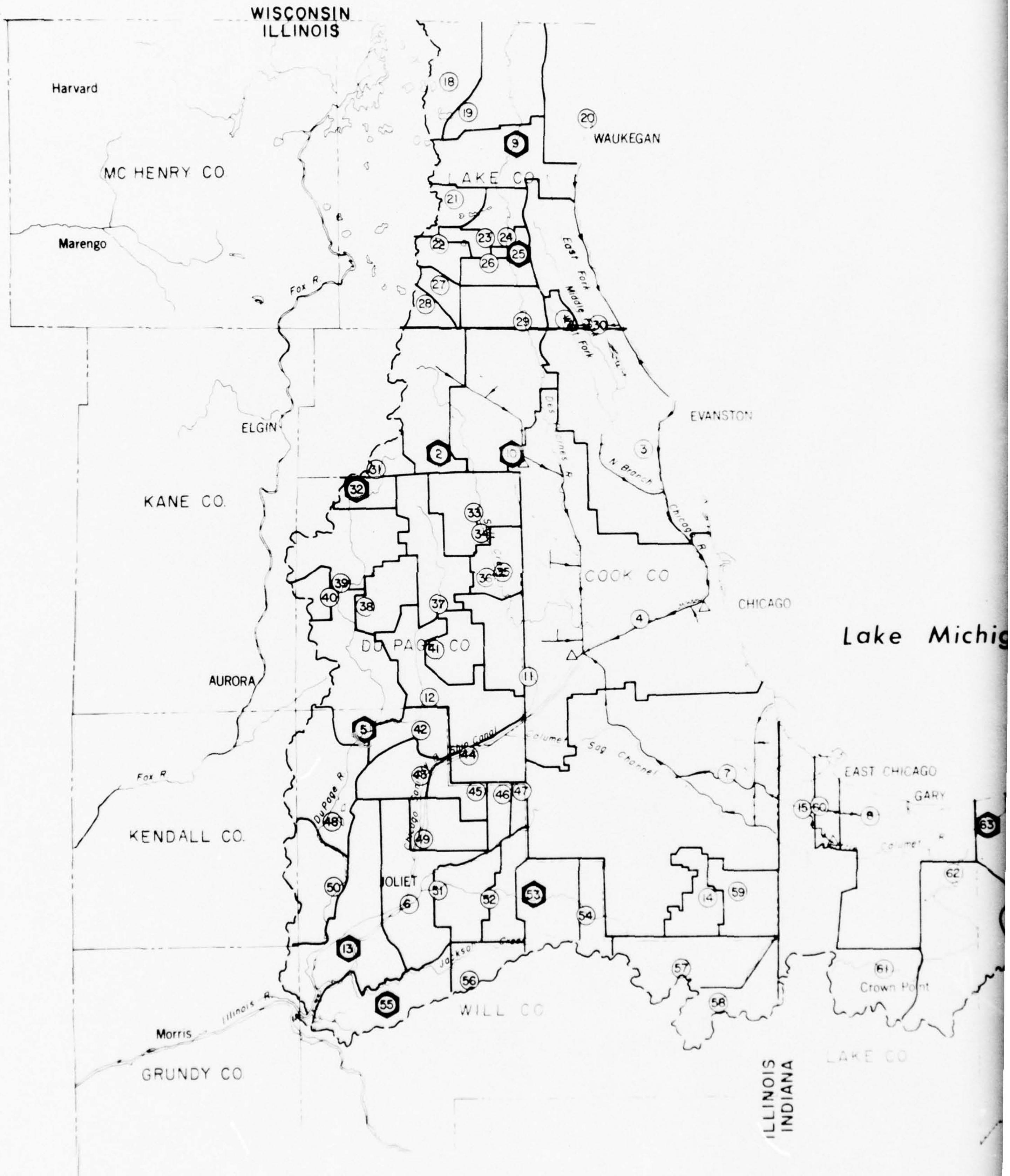
B. COMMON MANAGEMENT SYSTEM COMPONENTS

There are a number of system components which are common to all or to the majority of the five alternative management systems presented in this appendix. To facilitate alternative descriptions, these components are presented in this section prior to the description of each wastewater management alternative.

STORMWATER MANAGEMENT SYSTEMS

As presented in Appendix B, a variety of stormwater management systems have been designed for different land use areas. For the combined sewered areas, which consist mainly of the City of Chicago and several adjoining suburbs, stormwater runoff is managed by the use of comprehensive storage systems as contemplated in the Chicago Underflow Plan. This plan, which utilizes a large quarried storage site in the McCook-Summit area and two minor storage sites at the Stearns Quarry and O'Hare areas, is common to all alternatives (I thru V). For the combined sewered urban areas other than the City of Chicago, such as Waukegan, Joliet and Gary, stormwater management is provided through the use of mined storage facilities. The layout of these urban management systems is graphically presented in Figure D-II-B-1. The stormwater tunnels, which are mined in deep rock formations, augment the existing combined sewers and mitigate flooding and stream pollution problems by handling combined sewer overflows for ultimate treatment prior to discharge to the receiving streams.

A suburban stormwater management system, common to Alternatives II through V, is designed to meet the NDCP water quality goals of this study by treating some 98% of the runoff from the C-SELM suburban areas. For present suburbanized areas with combined sewers, the management system utilizes either mined or fenced shallow pits for stormwater storage supplemented with aeration facilities. Where land is available in separate sewer suburban areas, shallow pits are utilized for stormwater storage. Where space is at a premium in existing suburban areas, mixed storage areas function as stormwater storage facili-



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Harvard
MC HENRY CO
Marengo
Fox R
LAKE CO
WAUKEGAN
East Fork
Middle Fork
EVANSTON
ELGIN
KANE CO
N Branch
Chicago R
COOK CO
CHICAGO
Lake Michig
DU PAGE CO
AURORA
Calumet Sag Channel
Fox R
KENDALL CO
Du Page R
JOLIET
EAST CHICAGO
GARY
Calumet R
Illinois R
Morris
WILL CO
GRUNDY CO
Crown Point
LAKE CO
ILLINOIS
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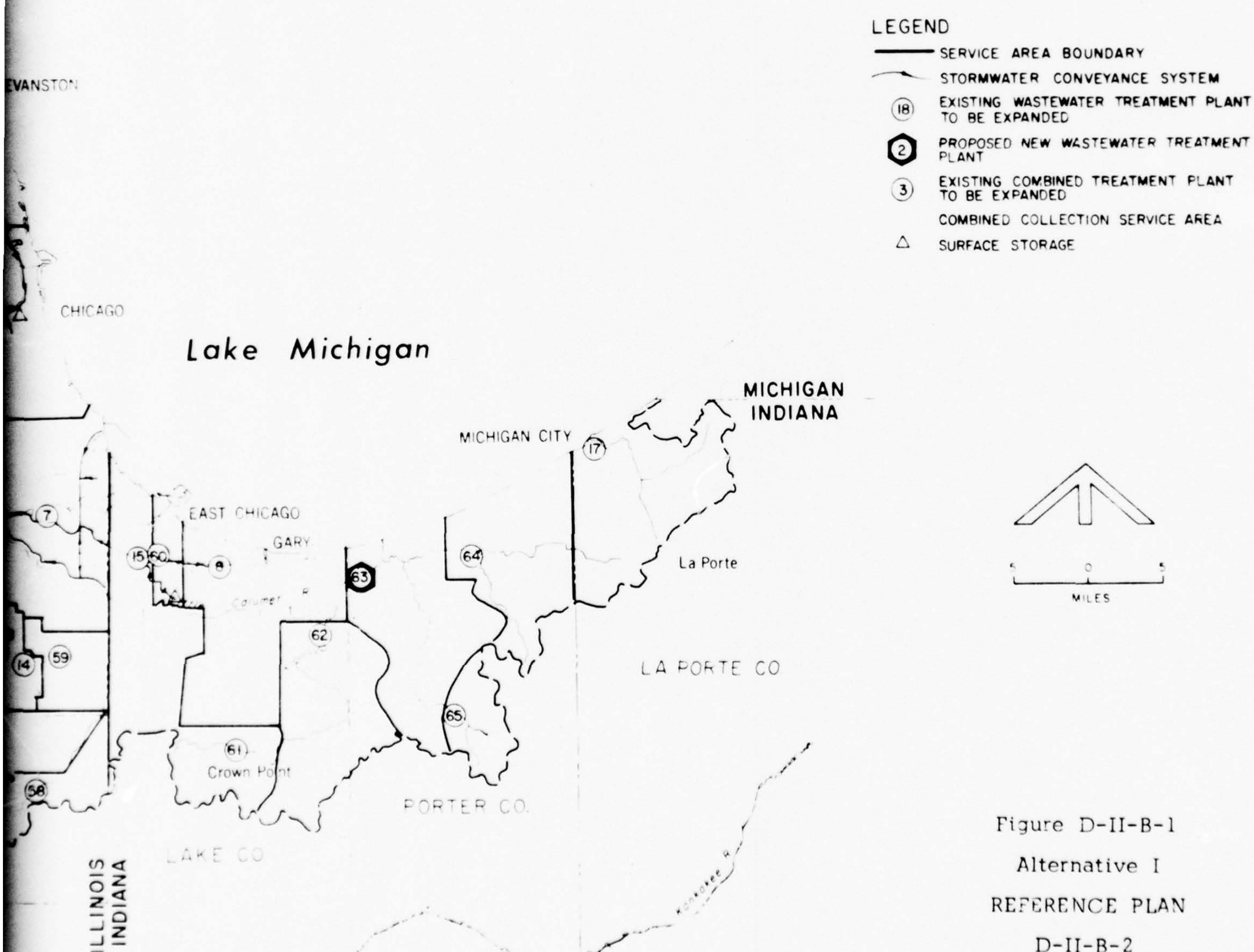


Figure D-II-B-1

Alternative I

REFERENCE PLAN

D-II-B-2

ties. Areas which are at present in rural land use and which are projected to be in suburban use by 1990 are provided stormwater storage through the conversion of rural stormwater retention basins to suburban shallow pit storage. The stormwater runoff in the urban and suburban storage facilities is ultimately conveyed to regional advanced wastewater treatment (AWT) plants or land treatment sites in order to meet the water quality goals of the study. The suburban stormwater management system is graphically presented in Figure D-II-B-2.

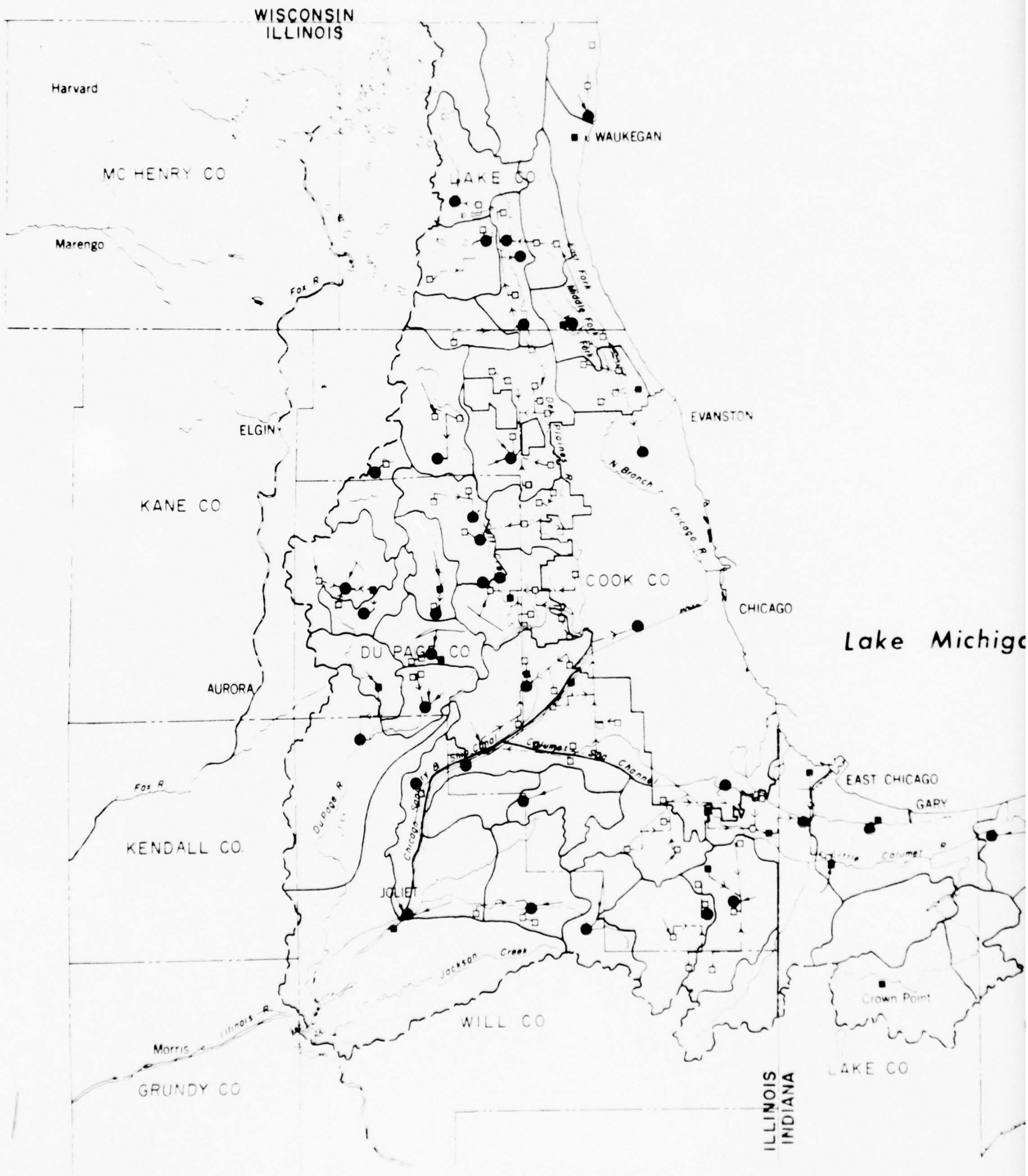
The rural stormwater management system is also common to Alternatives II through V. This management system incorporates land management and soil conservation practices which are designed to increase infiltration into the groundwater system (minimize stormwater runoff). The stormwater which does run off is channeled as overland flow to retention or storage basins. From these basins, the stormwater is conveyed to nearby spray irrigation machines which apply the water to the land for treatment by the "living filter". The renovated water is collected by a drainage system with subsequent discharge to a nearby natural watercourse.

ROCK AND RESIDUAL SOIL MANAGEMENT SYSTEMS

This management system includes the transport of rock and residual soil from tunnel, storage, and pipeline excavations from the point of origin to the point of final use or disposal. This management system is common to Alternatives I through V. Only the quantity of material, which is dependent on the degree of regional treatment and hence the extent of conveyance systems, varies between the alternative management systems. As presented in Appendix B, a variety of management opportunities exist for the final disposal of this material. Among the disposal opportunities studied were the construction of mountain landscapes and recreational islands in Lake Michigan and also the commercial utilization of rock material.

REUSE SYSTEMS

The reuse of high quality reclaimed water from AWT plants and land treatment sites is common to Alternatives II through V. Alternative I, which is designed to meet existing effluent standards, does not have reuse provisions since the water quality is not acceptable for potable and open body contact recreation purposes. Two reuse needs of the



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ILLINOIS
Harvard
WAUKEGAN
MC HENRY CO
LAKE CO
Marengo
Fox R
EVANSTON
ELGIN
Des Plaines R
N. Branch Chicago R
KANE CO
COOK CO
CHICAGO
Lake Michiga
DU PAGE CO
AURORA
Ship Canal
Calumet Sag Channel
Fox R
Du Page R
Chicago Sanitary & Ship Canal
EAST CHICAGO
GARY
KENDALL CO
Little Calumet R
JOLIET
Jackson Creek
Crown Point
WILL CO
Morris
Illinois R
LAKE CO
GRUNDY CO
ILLINOIS
INDIANA

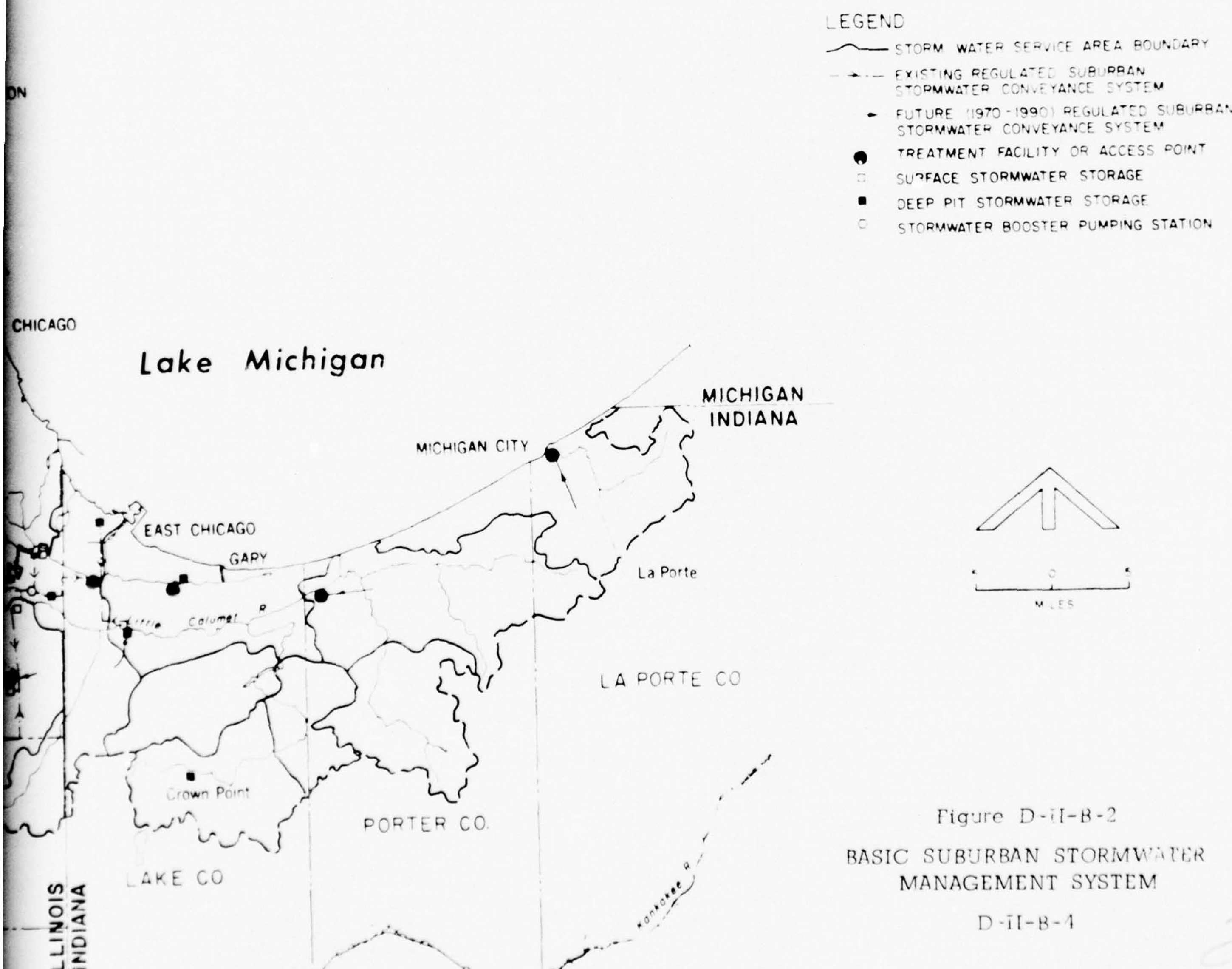


Figure D-II-B-2

BASIC SUBURBAN STORMWATER MANAGEMENT SYSTEM

C-SELM area are satisfied by the NDCP alternatives. These include the supply of potable waters to groundwater water supply deficient areas and the maintenance of adequate base flows in streams for recreational and navigational purposes. While the details of this management system are presented in Appendix B, the two options to meet the potable water supply needs of the area are generally presented and analyzed in this appendix. The first option assumes the continuance of the current 3200 CFS Lake Michigan withdrawal limitation for the State of Illinois. Thus, it is necessary to supply reclaimed rural stormwater and regional wastewater flows to selected potable water need areas. In the second option, the current Lake Michigan withdrawal restriction is arbitrarily considered inoperative with all C-SELM water supply deficient areas being supplied by Lake Michigan. Recreational and navigational reuse needs are supplied with reclaimed rural stormwater and regional reclaimed wastewater flows. The impact of these reuse systems on streamflows and water balances are presented in detail in Appendix D, Section V-B.

WASTEWATER TREATMENT SYSTEMS

At present there exist some 130 odd wastewater treatment plants in the C-SELM study area. The local planning agencies have examined these existing plants and have recommended the maintenance of some, the abandonment of others and the building of some new plants. These current local planning agency criteria are reflected in the 64 plants identified in Alternative I, the C-SELM Reference Plan which is discussed in Section D-II-C, Appendix D.

For the subsequent alternatives, i.e., Alternatives II through V, Table D-II-B-1 identifies those treatment plants of the 64 reference plants that are abandoned to meet the needs of the alternative management system. When a plant is abandoned, it functions as an access point for discharging wastewater into the regional conveyance system. Thus common to all alternatives is the location of 64 points which function as treatment facilities or access points to regional conveyance systems.

Table D-II-B-1

ABANDONED PLANTS IN THE C-SELM STUDY AREA

Plant Ref. No.	Name	ABANDONED PLANTS Alt I	Alt II	Alt III	Alt IV	Alt V
1	Deerfield		X	X	X	X
2	Salt Creek				X	X
3	North Side				X	
4	West-Southwest				X	
5	Spring Brook			X	X	X
6	Joliet				X	X
7	Calumet				X	
8	Gary				X	
9	Gurnee				X	X
10	O'Hare				X	X
11	Hinsdale				X	X
12	Lisle			X	X	X
13	Joliet-West			X	X	X
14	Bloom				X	X
15	Hammond				X	
16	Burns Ditch	X			X	X
17	Michigan City				X	X
18	Lindenhurst		X	X	X	X
19	Granwood Park		X	X	X	X
20	Waukegan			X	X	X
21	Vickory Manor		X	X	X	X
22	Sylvan Lake		X	X	X	X
23	Mundelein		X	X	X	X
24	Libertyville			X	X	X
25	New Mundelein		X	X	X	X
26	Vernon Hills		X	X	X	X
27	Ela		X	X	X	X
28	Lake Zurich East		X	X	X	X
29	Des Plaines				X	X
30	Clavey Road			X	X	X
31	Hanover		X	X	X	X
32	Bartlett		X	X	X	X
33-34	Addison				X	X
35-36	Elmhurst			X	X	X

Table D-II-B-1 (Continued)

Plant Ref. No.	Name	ABANDONED PLANTS Alt I	Alt II	Alt III	Alt IV	Alt V
37	Glen Ellyn			X	X	X
38	Wheaton			X	X	X
39	West Chicago				X	X
40	Nat. Accel. Lab.		X	X	X	X
41	Downers Grove				X	X
42	Citizens W. Suburban		X	X	X	X
43	Romeoville			X	X	X
44	Lemont			X	X	X
45	Lockport Heights		X	X	X	X
46	Chickawaw Hill		X	X	X	X
47	Derby Meadows		X	X	X	X
48	Plainfield		X	X	X	X
49	Lockport		X	X	X	X
50	Will County Water Co.		X	X	X	X
51	Oak Highlands		X	X	X	X
52	New Lenox		X	X	X	X
53	Mokena-Frankfort			X	X	X
54	Prestwick U.C.		X	X	X	X
55	Elmwood		X	X	X	X
56	Manhattan		X	X	X	X
57	Wood Hill		X	X	X	X
58	Township U.C.		X	X	X	X
59	E. Chicago Heights			X	X	X
60	East Chicago			X	X	X
61	Crown Point		X	X	X	X
62	Hobart			X	X	X
63	Portage		X	X	X	X
64	Chesterton			X	X	X
65	Valparaiso		X	X	X	X

II. DESCRIPTION OF REGIONAL WASTEWATER MANAGEMENT ALTERNATIVES

C. ALTERNATIVE WASTEWATER MANAGEMENT SYSTEM DESCRIPTIONS

ALTERNATIVE I - REFERENCE PLAN

Alternative I is structured to reflect wastewater management system planning as proposed by the regional planning agencies in the C-SELM study area. This alternative is comprised of 64 treatment plants of which 54 presently exist. This alternative is graphically presented in Figure D-II-B-1. The type of treatment at these regional facilities is such that present effluent guidelines or standards as set forth by the States of Indiana and Illinois will be met. These guidelines or standards and corresponding treatment types are presented in detail in Appendix B and Data Annex B. The only stormwater which is treated in this alternative (exclusive of stormwater infiltration) is that which is generated in combined sewer areas. The treatment plant capacities are based on the 1990 design flows which are presented in Table D-II-C-1 along with other pertinent treatment facility information. The conveyance system consists of pipelines and tunnels connecting combined stormwater storage with the 64 treatment plants. The conveyance system does not include the interconnecting between an estimated additional 78 outlying and existing treatment service areas and the 64 regional treatment plants of Alternative I inasmuch as this incremental conveyance is assumed to be within the responsibility of existing regional plans. A cost estimate has been made for this incremental conveyance system and is included in this appendix in Section V-A. The sludge management system for Alternative I incorporates the concept of agricultural utilization of sludge as a means of final disposal. For the eight Metropolitan Sanitary District of Greater Chicago (MSDGC) facilities, their anaerobically digested biological sludges are conveyed via pipeline to an agricultural area in Fulton County, Illinois, as graphically shown in Figure D-II-C-1. For the remaining 56 facilities in this alternative, the biologically stabilized sludge is conveyed by pipeline transmission to nearby agricultural sludge utilization areas as shown in Figure D-II-C-2.

Table D-II-C-1

TREATMENT FACILITY INFORMATION FOR ALTERNATIVE I

MAP REF NO	NAME	1 TYPE OF TREATMENT	2 LAND USE	TREATMENT FACILITY (ACRES)		SERVICE AREA (SQ. MI.)	POPULATION SERVED (1000'S)		PERCENT POPULATION SERVED IN SERVICE AREA		POPULATION DENSITY PEOPLE x 10^3 PER SQ. MILE		TREATMENT FACILITY CAPACITY IN M.G.D.		AVERAGE TREATMENT FACILITY FLOW (MGD) WITHOUT STORMWATER		AVERAGE TREATMENT FACILITY FLOW (MGD) WITH STORMWATER		RECEIVING STREAM
				1990	2020		1990	2020	1990	2020	1990	2020	1990	2020	1990	2020	1990	2020	
18	Lindenhurst	C	R	8.2	13.2	29.4	5.9	20.9	43	65	0.5	1.1	0.8	3.3	0.8	3.3			Mill Creek
19	Granwood Park	C	R	9.4	14.0	42.3	10.1	25.6	49	65	0.5	0.9	1.4	4.0	1.4	4.0			Mill Creek
9	Gurnee	C	S	23.8	28.5	56.9	88.6	139.8	96	100	1.6	2.5	14.9	24.8	14.9	24.8			Des Plaines
20	Waukegan	C	U	30.0	33.9	39.9	135.0	180.5	98	100	3.5	4.5	27.3	36.8	27.3	36.8			Des Plaines
21	Victory Manor	C	R	10.2	15.0	16.4	12.8	29.1	89	100	0.9	1.8	1.7	4.6	1.7	4.6			Ditch, Bull Cr
24	Libertyville	A	S	13.5	18.5	13.1	26.0	46.4	100	100	2.0	3.5	3.6	7.7	3.6	7.7			Des Plaines
22	Sylan Lake	C	S	8.2	10.6	10.5	3.8	12.5	66	95	0.6	1.3	0.5	1.9	0.5	1.9			Indian Creek
23	Mundelein	C	S	8.7	11.2	5.6	7.7	14.9	96	100	1.4	2.7	1.1	2.2	1.1	2.2			Hawthorn Cr
26	Vernon Hills	C	S	8.7	10.9	8.4	8.1	13.3	90	96	1.1	1.6	1.1	2.1	1.1	2.1			Hawthorn Cr
25	New Mundelein	C	S	10.6	14.0	6.6	13.9	24.5	97	99	2.2	3.7	1.9	3.9	1.9	3.9			Des Plaines
28	Lake Zurich East	C	R	8.2	10.2	11.3	2.1	10.5	38	80	0.5	1.2	0.3	1.7	0.3	1.7			Buffalo Cr Des Plaines
27	Ela	C	R	8.2	10.4	12.1	2.3	11.2	40	80	0.5	1.2	0.3	1.8	0.3	1.8			Tributary to Buffalo Cr
29	Des Plaines	B	S	20.2	28.4	47.4	112.9	146.5	92	99	2.4	47.4	10.1	23.7	10.1	23.7			Des Plaines
10	O'Hare	C	S	41.3	45.5	80.6	325.7	361.3	100	100	4.0	4.5	61.7	79.8	61.7	79.8			Des Plaines
2	Salt Creek	C	S	31.0	34.3	57.3	225.5	210.6	100	100	4.0	3.7	31.0	39.4	31.0	39.4			Salt Creek
33-34	Addison	B	S	27.5	32.9	34.3	149.3	192.8	100	100	4.4	5.6	22.9	34.3	22.9	34.3			Salt Creek
35-36	Elmhurst	A	S	19.9	22.1	14.4	66.8	71.8	100	100	4.6	5.0	9.7	12.6	9.7	12.6			Salt Creek
11	Hinsdale	A	S	23.4	26.1	24.6	108.5	114.8	100	100	4.4	4.7	15.1	19.3	15.1	19.3			Flagg Creek
43	Romeoville	A	S	15.0	19.3	21.9	22.8	55.1	78	99	1.3	2.5	4.6	9.2	4.6	9.2			Des Plaines
1	Deerfield	D	S	14.5	16.8	5.0	21.0	25.5	100	100	4.2	5.1	2.9	4.1	2.9	4.1			West Fork North Branch
30	Clavey Road	D	S	30.3	30.3	24.4	90.1	105.8	100	100	3.7	4.3	17.8	17.8	17.8	17.8			Skokie
3	North Side	D	U	272.2	307.2	139.7	1458.6	1498.6	100	100	10.4	10.7	453.6	512.0	392.8	432.2			North Shore Channel
4	West Southwest	D	U	693.0	762.0	264.3	2651.9	2786.2	100	100	10.0	10.5	1155.0	1270.0	936.6	1012.5			Sanitary & Ship Canal
15	Hammond	D	U	127.3	94.2	64.6	218.7	275.0	100	100	3.4	4.3	212.2	157.0	200.0	144.8			Grand Calumet
7	Calumet	D	U	318.0	377.5	285.0	1317.9	1474.1	100	100	4.6	5.2	530.0	629.1	419.3	484.8			Little Calumet

Table D-II-C-1 (Continued)

MAP REF NO.	NAME	1 TYPE OF TREATMENT	2 LAND USE	TREATMENT FACILITY (ACRES) 1990	TREATMENT FACILITY (ACRES) 2020	SERVICE AREA (SQ. MI.)	POPULATION SERVED (1000'S) 1990	POPULATION SERVED (1000'S) 2020	PERCENT POPULATION SERVED IN SERVICE AREA 1990	PERCENT POPULATION SERVED IN SERVICE AREA 2020	POPULATION DENSITY PEOPLE x 10^3 PER SQ. MILE 1990	POPULATION DENSITY PEOPLE x 10^3 PER SQ. MILE 2020	TREATMENT FACILITY CAPACITY IN M.G.D. 1990	TREATMENT FACILITY CAPACITY IN M.G.D. 2020	AVERAGE TREATMENT FACILITY FLOW (MGD) WITHOUT STORMWATER 1990	AVERAGE TREATMENT FACILITY FLOW (MGD) WITHOUT STORMWATER 2020	AVERAGE TREATMENT FACILITY FLOW (MGD) WITH STORMWATER 1990	AVERAGE TREATMENT FACILITY FLOW (MGD) WITH STORMWATER 2020	RECEIVING STREAM
58	Township U.C	C	R	9.9	15.0	23.1	9.0	19.6	88	92	0.4	0.9	1.1	3.0	1.1	3.0			Plum Creek
14	Bloom	D	U	32.2	35.0	39.3	78.5	99.5	97	99	2.1	2.6	20.1	25.9	20.1	25.9			Thorn Creek
59	East Chicago Heights	D	U	33.7	37.1	25.6	77.0	90.7	100	100	3.0	3.5	24.1	29.0	24.1	29.0			Deer Creek
57	Wood Hill	C	R	16.2	22.6	24.2	45.0	85.0	100	97	1.9	3.6	5.8	13.3	5.8	13.3			Deer Creek
44	Lemont	D	U	28.8	30.1	21.3	28.0	46.0	100	100	1.3	2.2	16.0	18.8	16.0	18.8			Sanitary & ship canal
49	Lockport	A	S	18.2	21.5	22.4	28.3	61.1	93	100	1.4	2.7	7.9	11.3	7.9	11.3			Deep Run
47	Derby Meadows	C	R	8.2	11.8	6.4	4.3	16.2	86	100	0.8	2.5	0.6	2.5	0.6	2.5			Long Run
46	Chickasaw Hill	B	R	8.2	12.2	6.8	4.6	17.1	87	100	0.8	2.5	0.6	2.6	0.6	2.6			Long Run
45	Lockport Heights	B	R	8.2	12.5	7.5	5.2	18.9	90	100	0.8	2.5	0.7	2.9	0.7	2.9			Long Run
54	Prestwick U.C	C	R	8.6	13.7	13.5	7.4	22.2	63	97	0.9	1.7	1.1	3.8	1.1	3.8			Hickory Creek
53	Mokena-Frankfort	C	R	10.9	18.0	26.0	14.4	43.4	65	97	0.9	1.7	2.1	7.5	2.1	7.5			Marley Creek
52	New Lenox	B	R	10.8	18.0	23.2	15.1	48.7	87	100	0.8	2.1	2.0	7.5	2.0	7.5			Hickory Creek
51	Oak Highlands	B	R	15.2	19.8	19.6	25.4	53.3	94	100	1.4	2.7	4.7	9.9	4.7	9.9			Hickory Creek
6	Joliet	A	U	31.7	37.1	57.8	138.5	216.5	98	99	2.5	3.8	32.0	47.6	32.0	47.6			Des Plaines
13	West Joliet	A	R	19.3	22.8	59.5	17.8	57.4	67	88	0.5	1.1	9.2	13.8	9.2	13.8			Des Plaines
56	Manhattan	C	R	8.2	8.2	20.6	0	0	0	0	–	0.2	0.5	1.0	0.5	1.0			Manhattan Creek
55	Elmwood	C	R	12.8	11.8	32.6	0	0	0	0	–	0.2	3.2	2.5	3.2	2.5			Manhattan Creek
31	Hanover	C	S	15.3	18.2	9.6	33.0	38.4	100	100	3.4	4.0	5.1	7.6	5.1	7.6			West Branch DuPage River
32	Bartlett	B	S	11.8	16.7	9.9	17.8	38.6	97	100	1.9	3.9	2.5	6.2	2.5	6.2			West Branch DuPage R
39	West Chicago	C	S	19.7	28.8	45.5	66.5	153.9	93	100	1.6	3.4	9.4	25.0	9.4	25.0			West Branch Du Page R
40	National Accelerator Laboratory	A	R	9.1	13.7	5.2	9.0	23.0	87	100	2.0	4.4	1.3	3.7	1.3	3.7			West Branch Du Page River
38	Wheaton	C	S	20.2	24.3	17.4	71.8	99.5	100	100	4.1	5.7	10.1	16.2	10.1	16.2			Spring Brook
5	Springbrook	A	R	21.4	30.4	59.3	86.3	190.4	95	99	1.5	3.2	11.9	30.4	11.9	30.4			DuPage River
37	Glen Ellyn	C	S	26.3	30.3	41.0	141.5	185.4	100	100	3.5	4.5	19.5	30.3	19.5	30.3			East Branch DuPage R
41	Downers Grove	C	S	20.4	23.3	29.4	74.0	85.6	100	100	2.5	2.9	10.2	14.1	10.2	14.1			St Joseph Creek

Table D-II-C-1 (Continued)

MAP REF NO.	NAME	TYPE OF TREATMENT (1)	LAND USE (2)	TREATMENT FACILITY (ACRES)		SERVICE AREA (SQ MI.)	POPULATION SERVED (1000'S)		PERCENT POPULATION SERVED IN SERVICE AREA		POPULATION DENSITY PEOPLE x 10^3 PER SQ MILE		TREATMENT FACILITY CAPACITY IN M.G.D.		AVERAGE TREATMENT FACILITY FLOW (MGD) WITHOUT STORMWATER		WITH STORMWATER		RECEIVING STREAM
				1990	2020		1990	2020	1990	2020	1990	2020	1990	2020	1990	2020	1990	2020	
12	Lisle	B	S	23.8	28.1	50.7	107.5	144.6	100	100	2.1	2.9	14.9	23.4	14.9	23.4			East Branch DuPage River
48	Plainfield	A	S	8.9	18.3	45.8	9.5	48.8	46	90	0.5	1.2	1.2	7.8	1.2	7.8			DuPage River
42	Citizens West Suburban	C	R	10.8	16.8	15.7	15.1	39.5	73	100	1.3	2.5	2.0	6.1	2.0	6.1			Lilly Cache Cr
50	Will County	A	R	11.2	18.9	26.6	16.8	54.4	79	100	0.8	2.0	2.2	8.4	2.2	8.4			DuPage River
60	East Chicago	E	U	38.7	32.7	13.6	50.2	54.2	100	100	3.7	4.0	53.8	34.1	53.8	34.1			Grand Calumet
8	Gary	E	U	70.3	71.8	96.5	229.9	268.3	100	100	2.4	2.8	140.6	143.5	123.5	126.4			Grand Calumet
61	Crown Point	E	S	12.3	17.2	22.4	21.9	43.8	86	100	1.1	2.0	2.8	6.6	2.8	6.6			Deep River
62	Hobart	E	S	20.7	28.9	79.4	83.3	169.7	80	91	1.3	2.3	10.6	25.7	10.6	25.7			Deep River
63	Portage	E	S	28.7	42.7	81.4	68.0	234.5	72	93	1.2	3.1	25.2	66.5	25.2	66.5			Little Calumet
64	Chesterton	E	S	27.5	34.6	80.5	18.5	91.8	45	74	0.5	1.5	22.5	39.3	22.5	39.3			Little Calumet
65	Valparaiso	E	S	12.2	18.2	21.7	20.5	47.7	90	100	1.1	2.2	2.7	7.6	2.7	7.6			Tributary Little Calumet
17	Michigan City	E	U	20.2	24.9	90.6	57.0	91.0	88	75	0.7	1.3	10.1	17.8	10.1	17.8			Trail Creek

[1] A - Conventional Secondary Treatment (BOD-20 mg/l, SS-25 mg/l)
B - A plus Filtration (BOD-10 mg/l, SS-12 mg/l)
C - B plus Filtration (BOD- 4 mg/l, SS- 5 mg/l)
D - C plus Nitrification (BOD- 4 mg/l, SS-5 mg/l, NH_3-N-2.5 mg/l)
E - A plus 80% Phosphorus Removal (BOD-20 mg/l, SS-25 mg/l)

[2] Land use consistent with existing regional plans.
U - Urban
S - Suburban
R - Rural

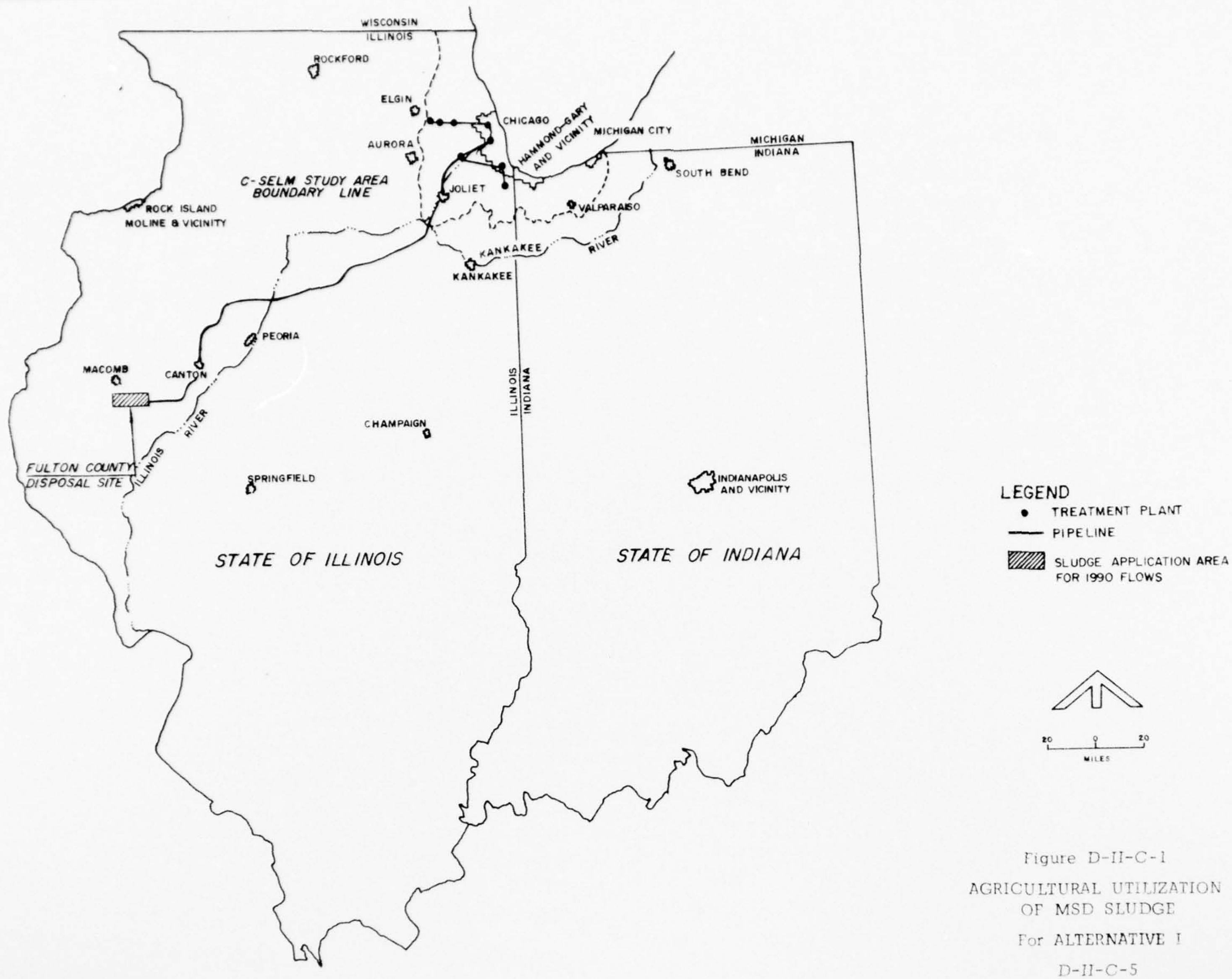
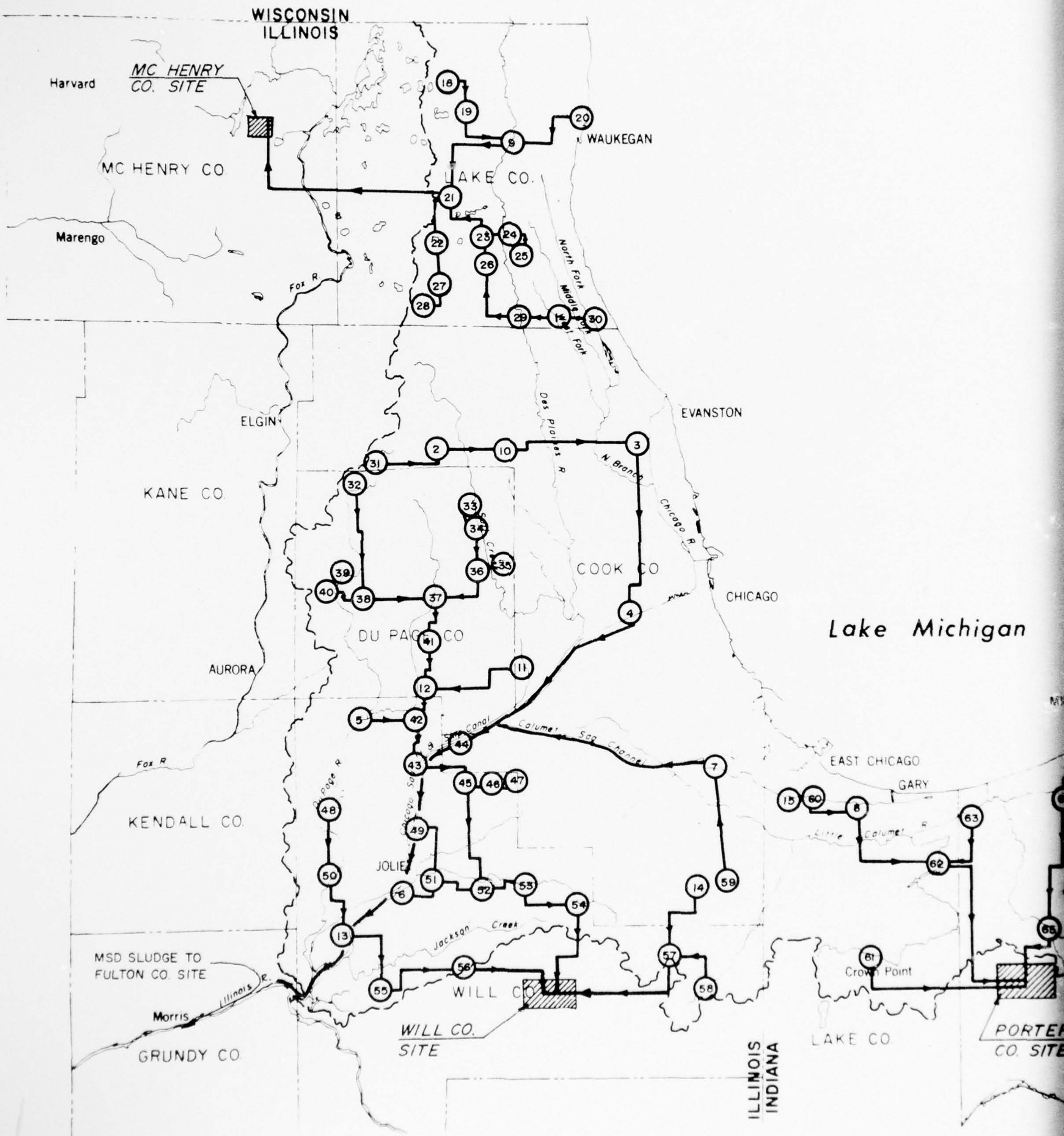


Figure D-II-C-1

AGRICULTURAL UTILIZATION OF MSD SLUDGE

For ALTERNATIVE I



WISCONSIN
ILLINOIS
Harvard
MC HENRY CO. SITE
WAUKEGAN
MC HENRY CO
LAKE CO.
Marengo
North Fork
Middle Fork
Fox R
Des Plaines R
EVANSTON
ELGIN
N Branch
Chicago R
KANE CO
COOK CO
CHICAGO
Lake Michigan
DU PAGE CO
AURORA
Canal
Calumet Sag Channel
Fox R
EAST CHICAGO
GARY
KENDALL CO
Little Calumet R
JOLIET
Jackson Creek
Crown Point
MSD SLUDGE TO FULTON CO. SITE
Illinois R.
Morris
WILL CO
WILL CO. SITE
LAKE CO
PORTER CO. SITE
GRUNDY CO
ILLINOIS
INDIANA

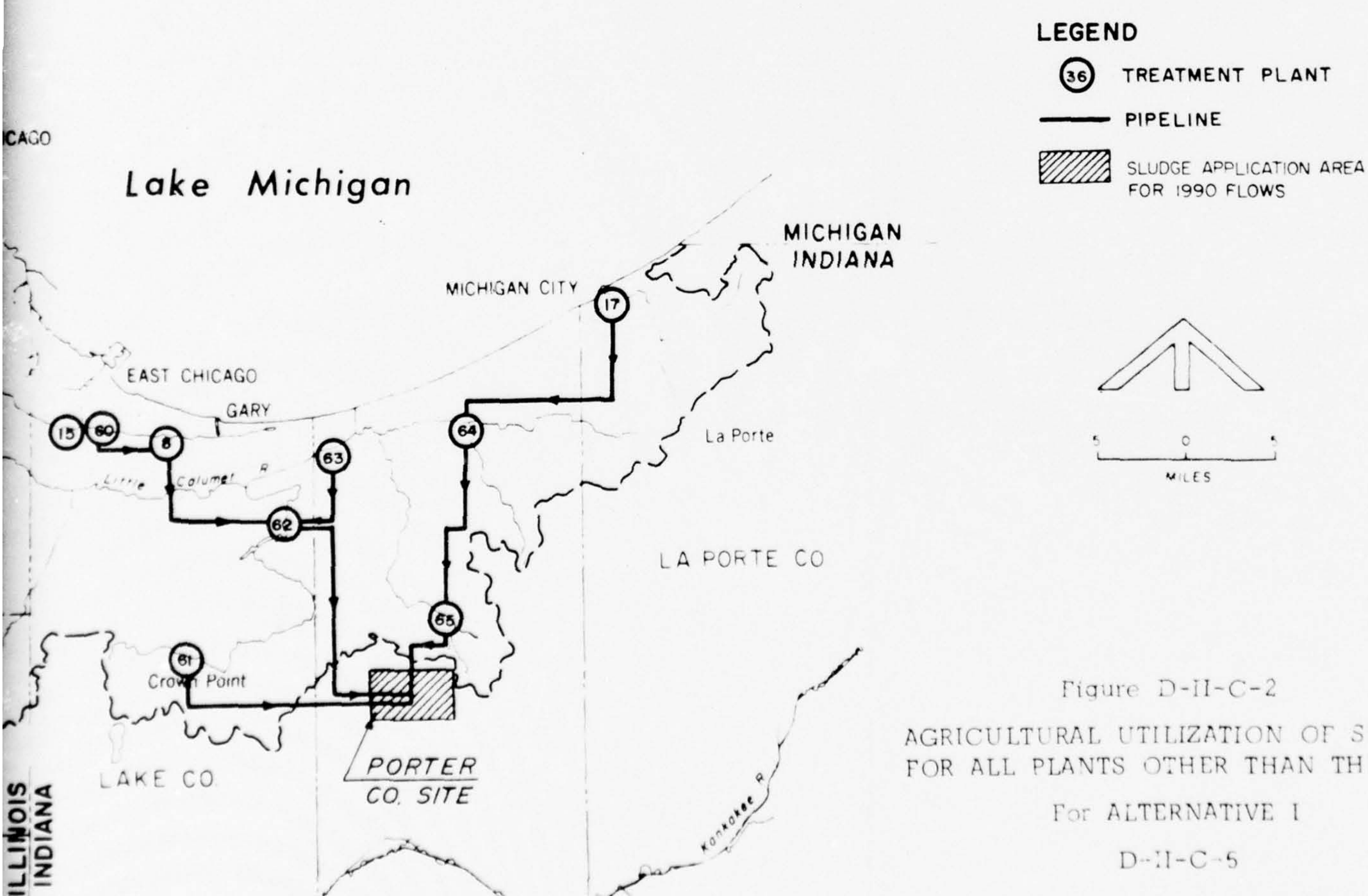


Figure D-II-C-2

AGRICULTURAL UTILIZATION OF SLUDGE FOR ALL PLANTS OTHER THAN THE MSD

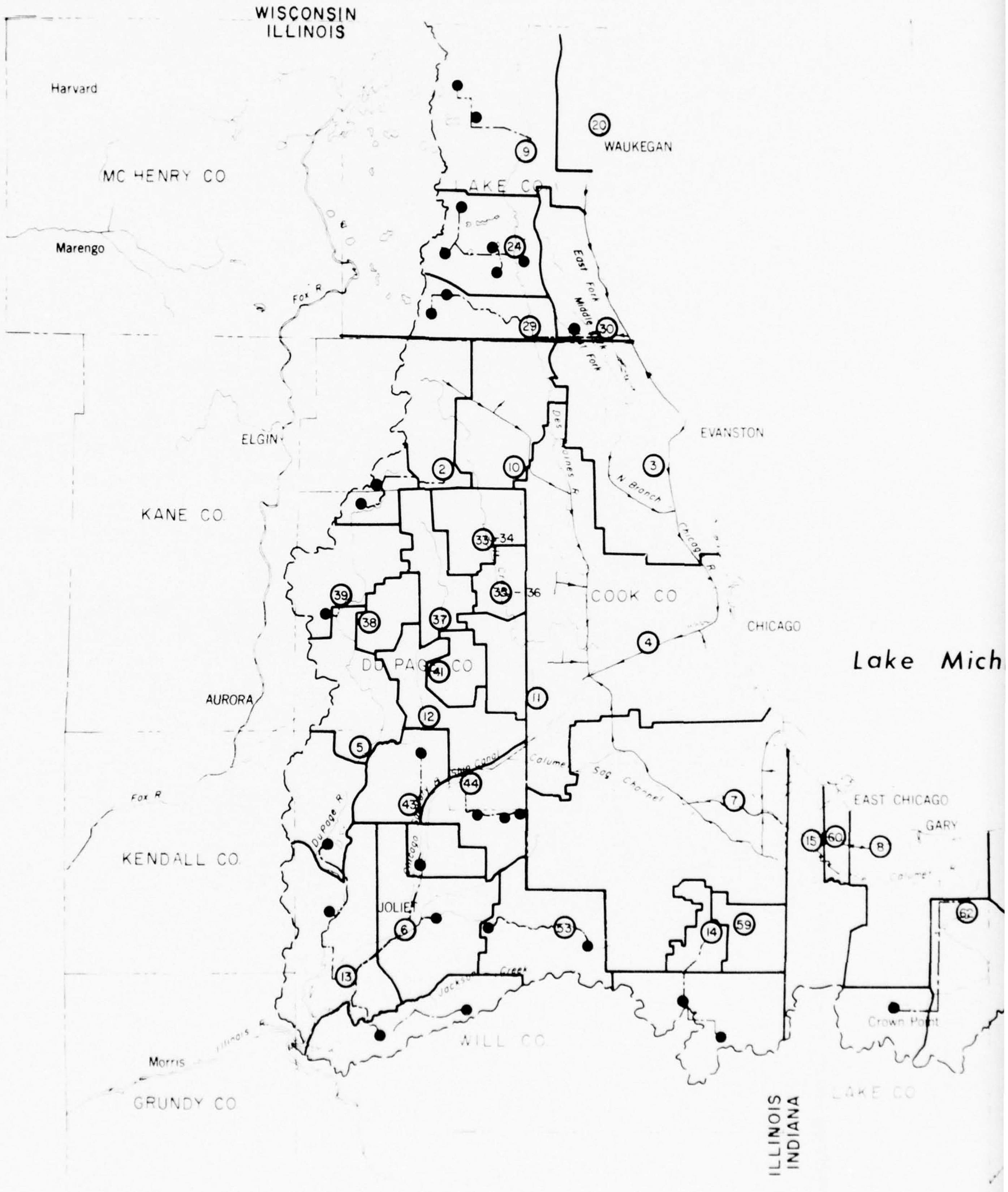
For ALTERNATIVE I

ALTERNATIVE II - PHYSICAL-CHEMICAL TREATMENT PLAN

The physical-chemical treatment technology is utilized in Alternative II to conform to the NDCP water quality standard. As shown in Figure D-II-C-3, this plan is comprised of 33 treatment plants. The purpose of this regionalization of service areas from the previous 64 treatment plants is to take advantage of the economy of scale available for treatment plants by eliminating the relatively small (less than 10 MGD capacity) AWT plants. Pertinent treatment facility information for this alternative is presented in Table D-II-C-2. A regulated flow conveyance system as shown in Figure D-II-C-3 is designed to accomplish this regionalization by incorporating 31 abandoned plant sites or access points into the 33 physical-chemical regional facilities. Due to the high lime content of the physical-chemical sludge, the sludge management system for Alternative II incorporates an agricultural sludge utilization program for soil pH control and final disposal. Presented in Figure D-II-C-4 are the sludge conveyance systems and application areas for this plan.

ALTERNATIVE III - ADVANCED BIOLOGICAL TREATMENT PLAN

For Alternative III, the advanced biological treatment technology is specified to meet the NDCP water quality goal. As depicted in Figure D-II-C-5, this is a 17 treatment plant system which is designed to incorporate the larger secondary treatment facilities existing in the C-SELM study area. Presented in Table D-II-C-3 is the pertinent treatment facility data for this alternative. The conveyance system which accomplished this regional treatment scheme is also graphically presented in Figure D-II-C-5. For this alternative, two disposal options are presented for the sludge management system. In the first option, the stabilized sludge from the 17 advanced biological treatment plants is conveyed by a pipeline transmission system to nearby agricultural sludge utilization areas as presented in Figure D-II-C-6. In this system, the sludge is applied to the land in yearly applications to enhance the organic and nutrient content of the soils for increased crop production. The second sludge management option also includes pipeline transmission of the stabilized sludge to utilization areas. However in this plan, the utilization areas are unproductive strip-mined areas which are located at appreciable distances from the C-SELM area as shown in Figure D-II-C-7. For this option large applications of sludge are made over a short time period to reclaim the land for more productive use.


WISCONSIN
ILLINOIS
Harvard
MC HENRY CO
Marengo
Fox R
LAKE CO
WAUKEGAN
East Fork
Middle Fork
ELGIN
EVANSTON
Des Plaines R
N Branch Chicago R
KANE CO
COOK CO
CHICAGO
Lake Mich
DU PAGE CO
AURORA
Fox R
Calumet Sag Channel
Du Page R
KENDALL CO
EAST CHICAGO
GARY
JOLIET
Jackson Creek
Crown Point
Illinois R
Morris
WILL CO
GRUNDY CO
LAKE CO
ILLINOIS
INDIANA
20
9
24
29
30
2
10
3
33-34
35-36
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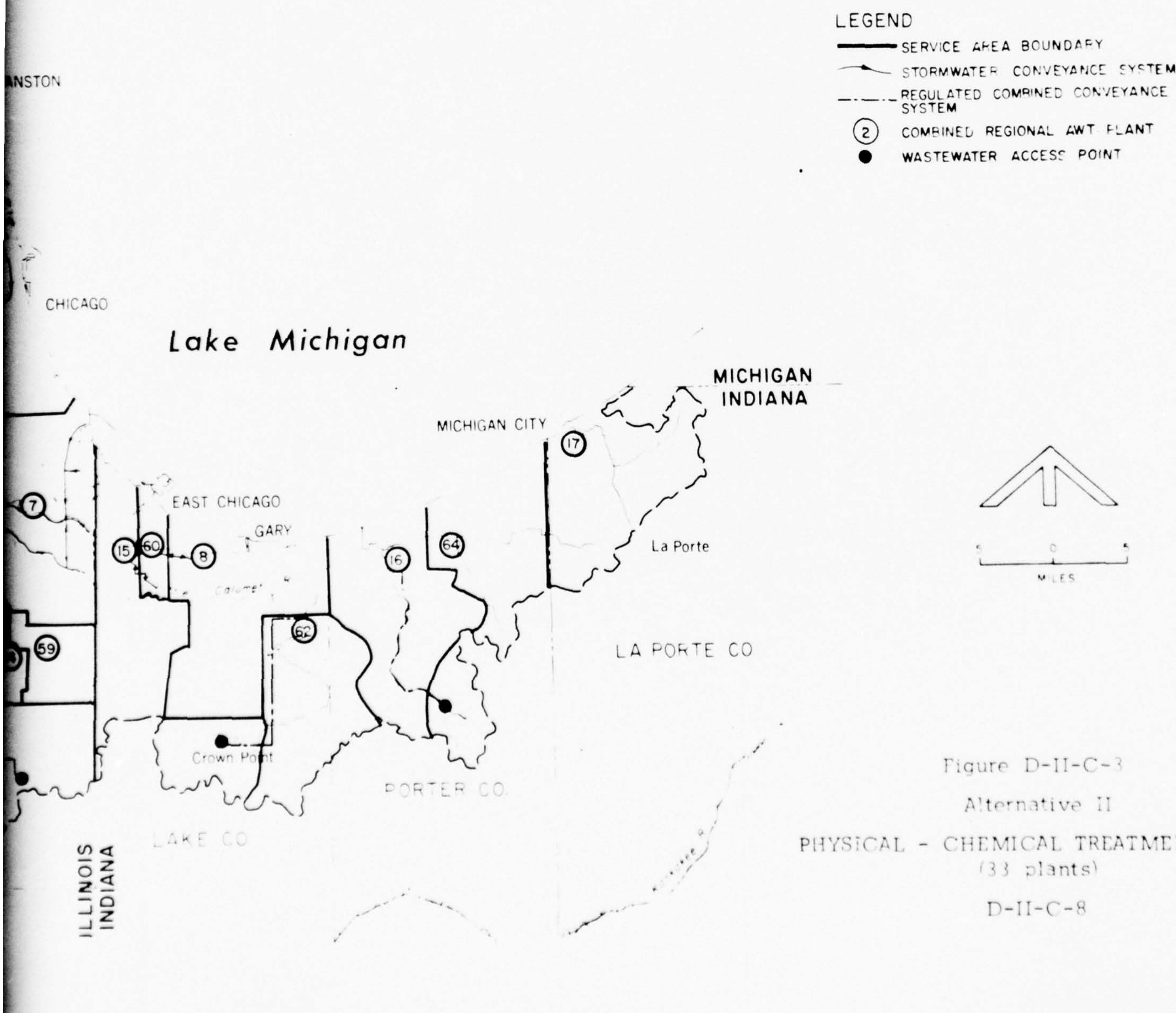


Figure D-II-C-3

Alternative II

PHYSICAL - CHEMICAL TREATMENT PLAN
(33 plants)

Table D-II-C-2

TREATMENT FACILITY INFORMATION FOR ALTERNATIVE II

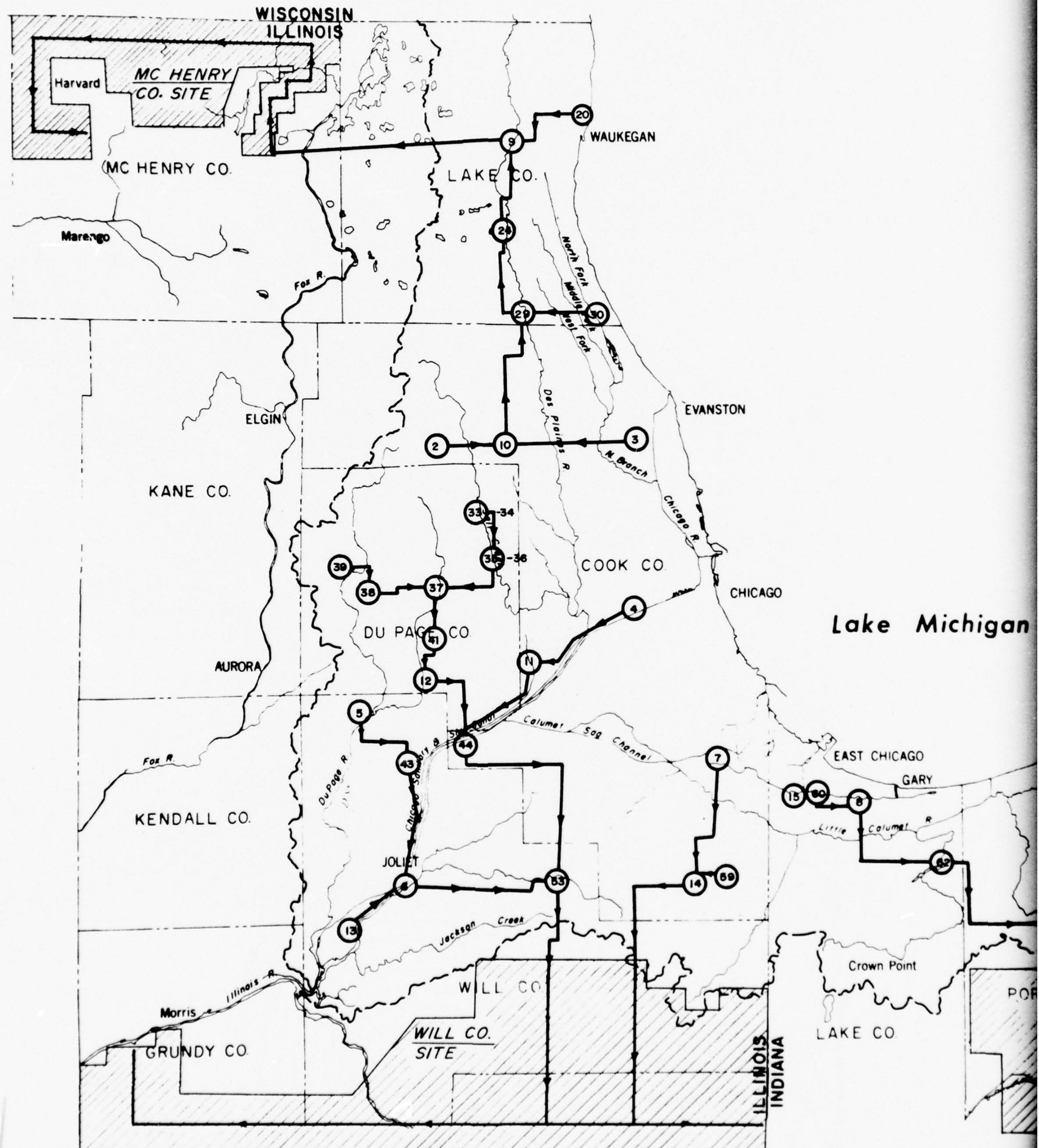
MAP REF NO	NAME	1 TYPE OF TREATMENT	2 LAND USE	TREATMENT FACILITY (ACRES) 1990	TREATMENT FACILITY (ACRES) 2020	SERVICE AREA (SQ. MI.)	POPULATION SERVED (1000'S) 1990	POPULATION SERVED (1000'S) 2020	PERCENT POPULATION SERVED IN SERVICE AREA 1990	PERCENT POPULATION SERVED IN SERVICE AREA 2020	POPULATION DENSITY PEOPLE x 10^3 PER SQ. MILE 1990	POPULATION DENSITY PEOPLE x 10^3 PER SQ. MILE 2020	TREATMENT FACILITY CAPACITY IN M.G.D. 1990	TREATMENT FACILITY CAPACITY IN M.G.D. 2020	AVERAGE TREATMENT FACILITY FLOW (MGD) WITHOUT STORMWATER 1990	AVERAGE TREATMENT FACILITY FLOW (MGD) WITHOUT STORMWATER 2020	AVERAGE TREATMENT FACILITY FLOW (MGD) WITH STORMWATER 1990	AVERAGE TREATMENT FACILITY FLOW (MGD) WITH STORMWATER 2020	RECEIVING STREAM
9	Gurnee	PC	S	19.7	26.9	128.6	104.6	186.3	83	88	1.0	1.6	23.7	53.8	17.1	32.1	20.6	42.1	Des Plaines
20	Waukegan	PC	U	22.5	26.3	399	135.0	180.5	98	100	3.5	4.5	32.6	49.1	27.3	36.8	30.0	42.0	Des Plaines
24	Libertyville	PC	S	25.0	31.6	606	72.3	140.7	93	99	1.3	2.3	43.8	79.0	9.9	22.4	25.7	53.4	Des Plaines
29	Des Plaines	PC	S	28.9	35.5	75.8	99.3	193.7	91	97	1.4	2.6	62.9	101.5	13.6	31.3	38.7	67.0	Des Plaines
10	O'Hare	PC	S	38.1	47.6	80.6	325.7	361.3	100	100	4.1	4.5	108.9	136.0	61.7	79.8	85.7	108.4	Des Plaines
2	Salt Creek	PC	S	30.9	35.7	76.8	276.3	287.6	100	100	3.6	3.7	77.3	101.9	48.6	53.2	63.2	78.0	Salt Creek
33-34	Addison	PC	S	30.1	32.8	34.3	149.3	192.8	100	100	4.4	5.6	70.0	86.2	22.9	34.3	46.8	60.7	Salt Creek
35-36	Elmhurst	PC	S	25.9	26.8	14.4	66.8	71.8	100	100	4.6	5.0	49.8	52.7	9.7	12.6	30.1	33.0	Salt Creek
11	Hinsdale	PC	S	28.7	29.3	24.6	108.5	114.8	100	100	4.4	4.7	60.9	65.1	15.1	19.3	38.4	42.6	Flagg Creek
43	Romeoville	PC	S	17.9	22.9	37.6	37.9	94.6	76	100	1.3	2.5	18.3	35.3	6.6	15.3	12.6	25.5	Des Plaines
30	Clavey Road	PC	S	17.6	17.6	24.4	129.1	105.8	100	100	5.3	4.3	17.8	17.8	17.8	17.8	17.8	17.8	Skokie
3	North Side	PC	U	167.1	187.5	139.7	1458.6	1498.6	100	100	10.5	10.7	477.4	535.8	392.8	432.2	402.8	444.3	North Shore Channel
4	West-Southwest	PC	U	416.1	457.5	264.3	2651.9	2786.2	100	100	10.0	10.5	1188.9	1307.1	936.6	1012.5	950.0	1033.0	Sanitary & Ship Canal
15	Hammond	PC	U	81.3	64.0	64.6	218.7	275.0	100	100	3.4	4.3	232.2	182.8	200.0	144.8	210.2	157.9	Grand Calumet
7	Calumet	PC	U	193.0	230.0	285.0	1317.9	1474.1	100	100	4.6	5.2	251.3	657.1	419.3	484.8	430.0	497.1	Little Calumet
14	Bloom	PC	U	26.6	33.4	86.6	132.5	204.1	97	97	1.6	2.4	50.5	87.8	27.0	42.2	39.0	65.3	Thorn Creek
59	East Chicago Heights	PC	U	27.7	31.0	25.6	77.0	90.7	100	100	3.0	3.5	57.8	73.7	24.1	29.0	41.2	51.7	Deer Creek
44	Lemont	PC	U	21.2	28.6	42.0	42.1	98.2	95	100	1.1	2.3	29.5	60.8	17.9	26.8	23.7	44.0	Sanitary & Ship Canal
53	Mokena-Frankfort	PC	R	20.9	27.9	62.7	36.9	114.3	72	98	0.8	1.9	27.5	58.6	5.2	18.8	16.5	39.0	Marley Creek
6	Joliet	PC	U	31.6	51.1	153.0	192.2	330.9	96	96	1.3	2.3	79.1	145.9	48.3	72.3	64.0	109.7	Des Plaines
13	West Joliet	PC	R	16.4	24.2	131.9	44.1	160.6	64	92	0.5	1.3	14.9	40.4	12.6	30.0	13.8	35.3	Des Plaines
39	West Chicago	PC	S	23.9	28.4	50.7	75.5	176.9	92	100	1.6	3.5	37.9	60.2	10.7	28.7	24.5	44.7	West Branch DuPage River
38	Wheaton	PC	S	18.7	22.5	17.4	71.8	99.5	100	100	4.1	5.7	20.5	32.2	10.1	16.2	15.4	24.3	Spring Brook
5	Spring Brook	PC	R	18.3	25.5	59.3	86.3	190.4	95	99	1.5	3.2	19.3	46.3	11.9	30.4	15.7	38.5	DuPage River
37	Glen Ellyn	PC	S	23.8	26.5	41.0	141.5	185.4	100	100	2.5	4.5	37.8	50.0	19.5	30.3	28.8	40.3	East Branch DuPage River

Table D-II-C-2 (Continued)

MAP REF NO.	NAME	TYPE OF TREATMENT[1]	LAND USE[2]	TREATMENT FACILITY (ACRES)		SERVICE AREA (SQ. MI.)	POPULATION SERVED (1000'S)		PERCENT POPULATION SERVED IN SERVICE AREA		POPULATION DENSITY PEOPLE x 10^3 PER SQ. MILE		TREATMENT FACILITY CAPACITY IN M.G.D.		AVERAGE TREATMENT FACILITY FLOW (MGD)				RECEIVING STREAM
															WITHOUT STORMWATER		WITH STORMWATER		
				1990	2020		1990	2020	1990	2020	1990	2020	1990	2020	1990	2020	1990	2020	
41	Downers Grove	PC	S	22.5	24.6	29.4	74.0	85.6	100	100	2.5	2.9	32.7	41.0	10.2	14.1	21.6	27.8	St Joseph Cr
12	Lisle	PC	S	20.9	23.8	50.7	107.5	144.6	100	100	2.1	2.9	27.5	38.4	14.9	23.4	21.3	31.0	East Branch DuPage River
60	East Chicago	PC	U	26.9	22.8	13.6	50.2	54.2	100	100	3.7	4.0	53.8	34.1	53.8	34.1	53.8	34.1	Grand Calumet
8	Gary	PC	U	49.2	52.5	96.5	229.9	268.3	100	100	2.4	2.8	140.6	150.0	123.5	126.4	123.5	129.8	Grand Calumet
62	Hobart	PC	S	19.8	27.0	101.8	105.2	213.5	81	93	1.3	2.3	24.8	54.6	13.4	32.3	19.2	43.6	Deep River
16	Burns Ditch	PC	S	24.6	43.2	103.1	88.5	282.2	76	95	1.1	2.9	41.1	123.5	27.9	74.1	34.7	99.2	Little Calumet
64	Chesterton	PC	S	19.8	24.2	80.5	18.5	91.8	45	74	0.5	1.5	22.5	39.3	22.5	39.3	22.5	39.3	Little Calumet
17	Michigan City	PC	U	20.3	24.6	90.6	57.0	91.0	88	75	0.7	1.3	26.0	41.0	10.1	17.8	18.2	29.6	Trail Creek

[1]PC - Physical-Chemical Treatment.

[2]Land Use consistent with existing regional plans.
U - Urban
S - Suburban
R - Rural



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Middle Fork
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Calumet Sag Channel
EAST CHICAGO
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Little Calumet R.
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Illinois R.
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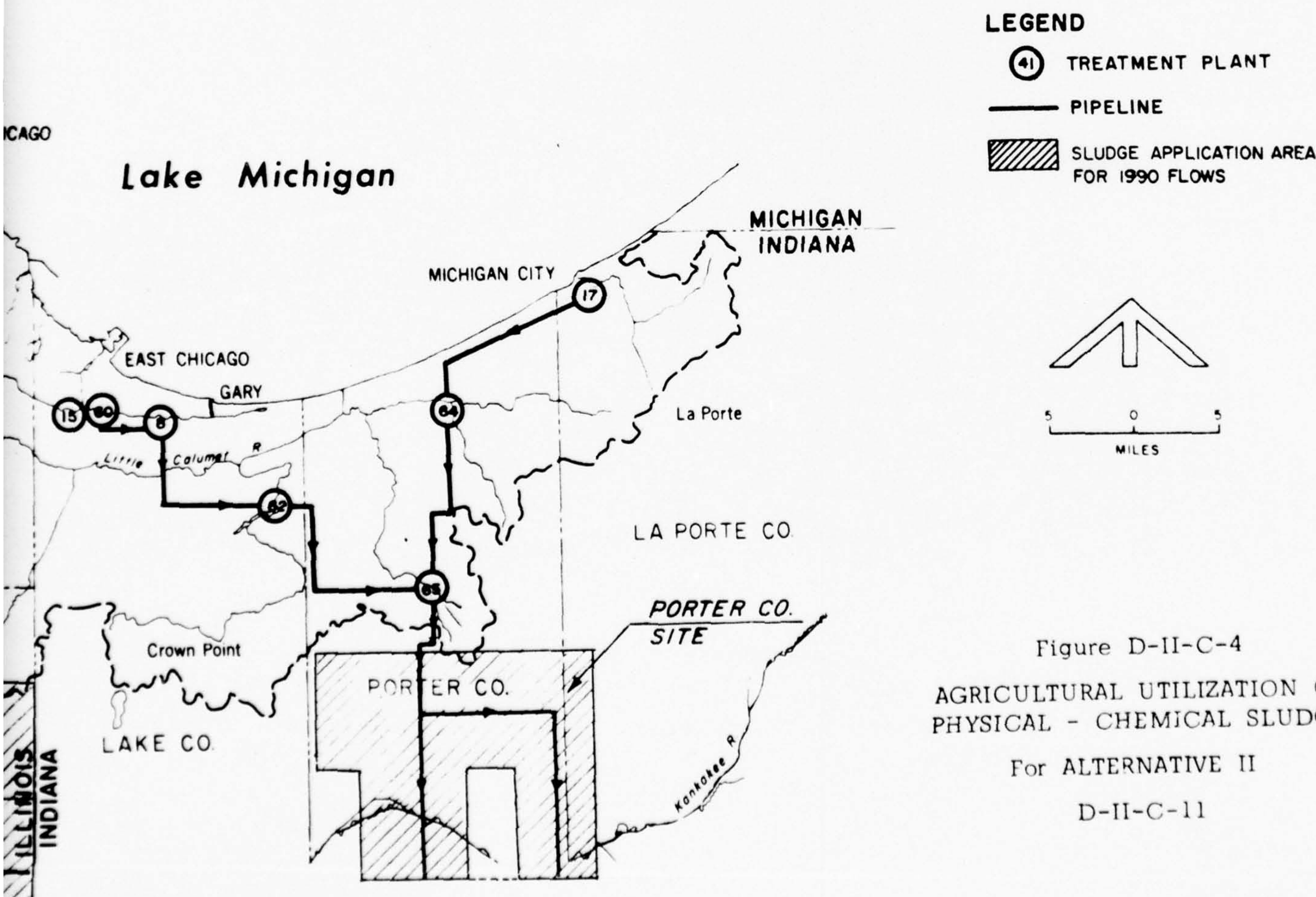
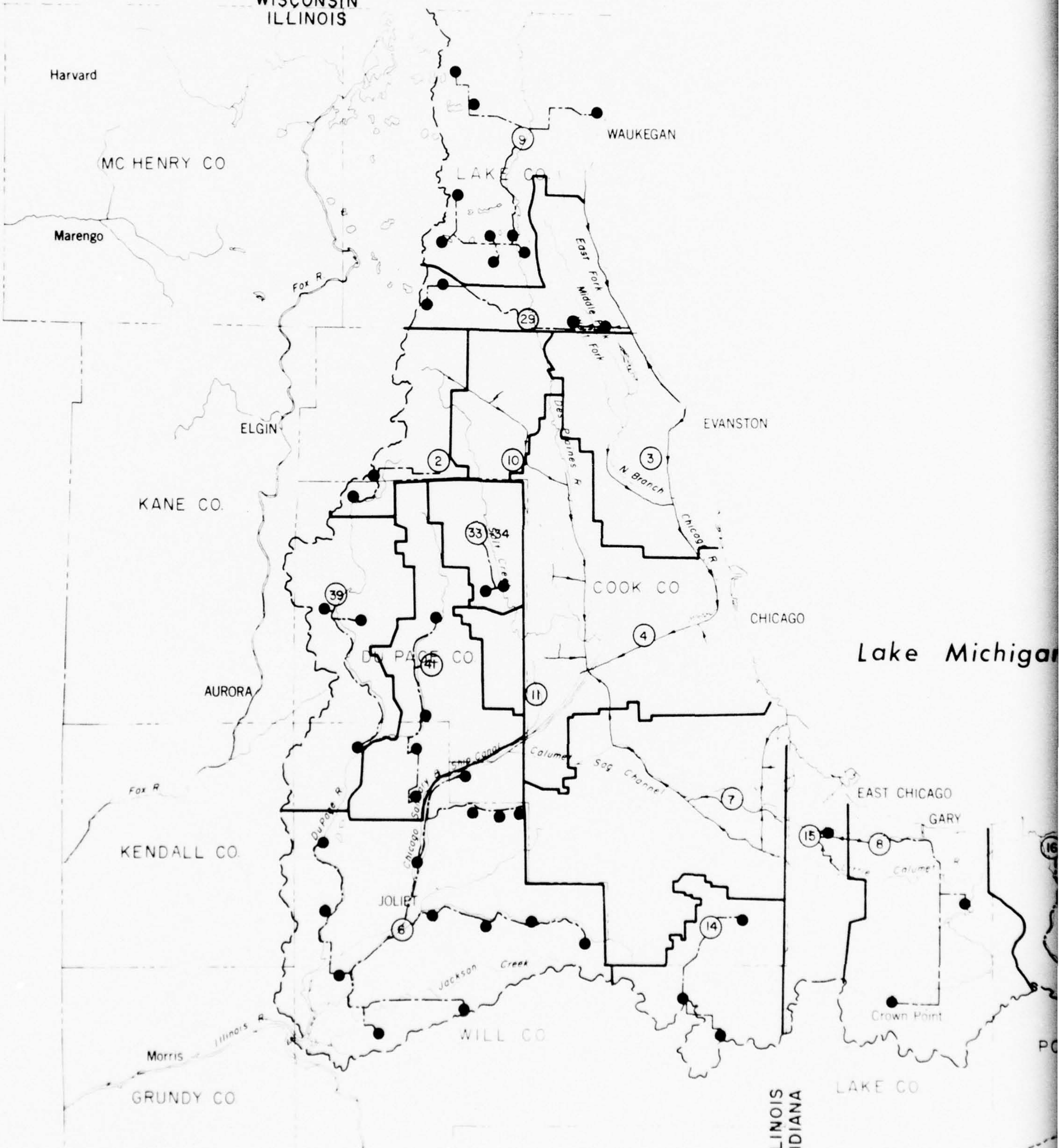


Figure D-II-C-4

AGRICULTURAL UTILIZATION OF PHYSICAL - CHEMICAL SLUDGE

For ALTERNATIVE II



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Du Page R
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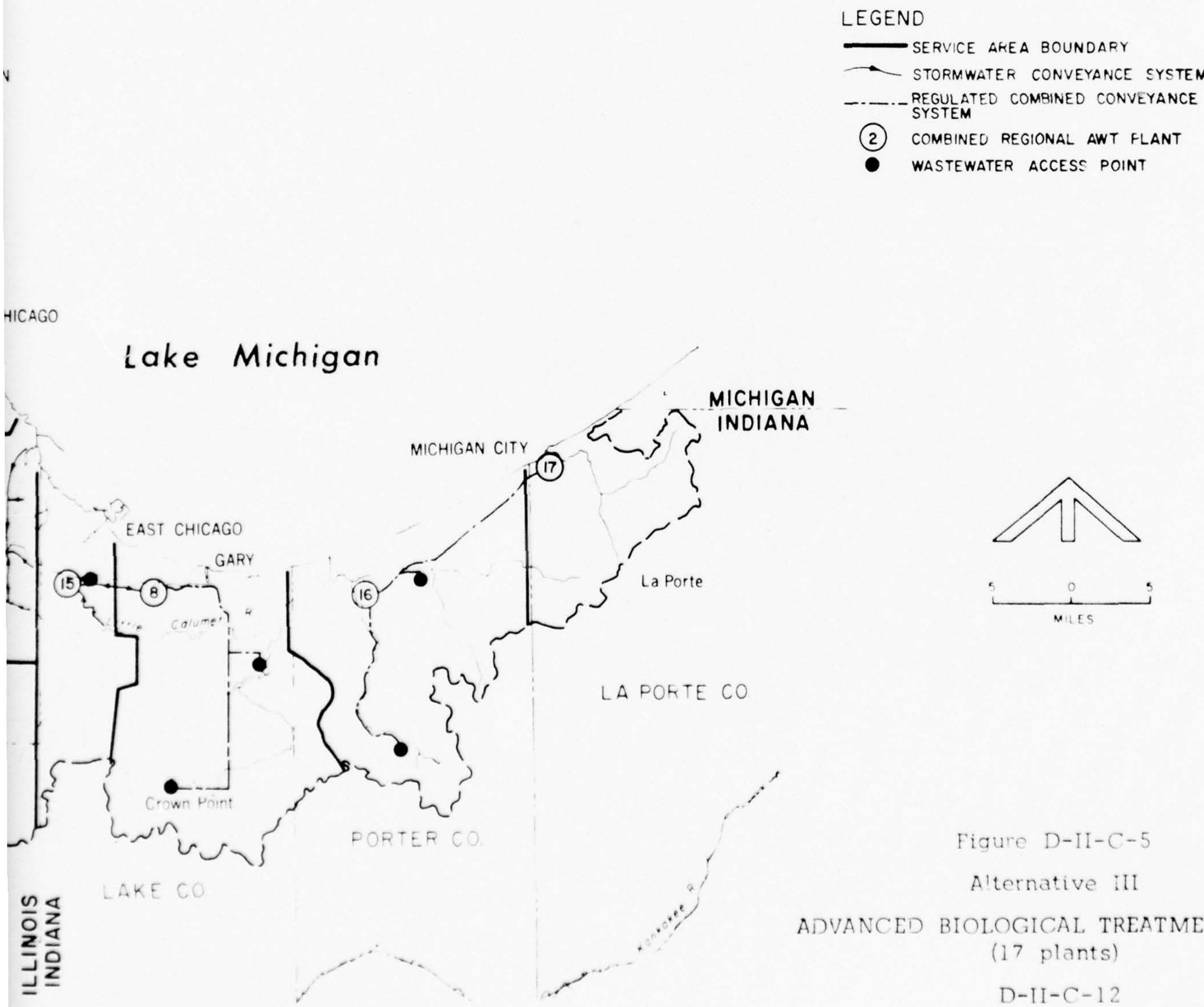


Figure D-II-C-5

Alternative III

ADVANCED BIOLOGICAL TREATMENT PLAN
(17 plants)

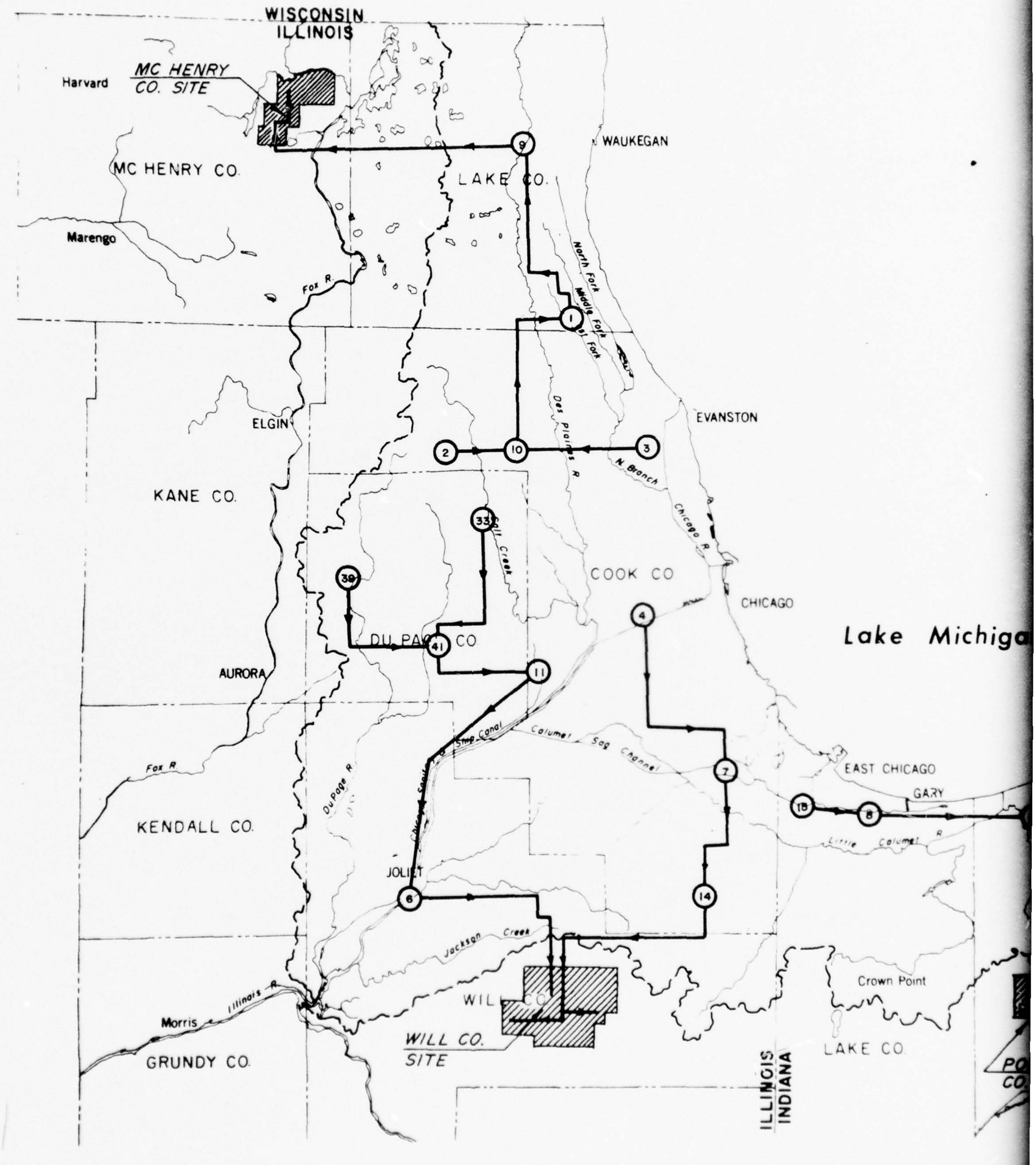
Table D-II-C-3

TREATMENT FACILITY INFORMATION FOR ALTERNATIVE III

MAP REF NO.	NAME	TYPE OF TREATMENT[1]	LAND USE[2]	TREATMENT FACILITY (ACRES)		SERVICE AREA (SQ MI.)	POPULATION SERVED (1000'S)		PERCENT POPULATION SERVED IN SERVICE AREA		POPULATION DENSITY PEOPLE x 10^3 PER SQ MILE		TREATMENT FACILITY CAPACITY IN M.G.D.		AVERAGE TREATMENT FACILITY FLOW (MGD) WITHOUT STORMWATER		AVERAGE TREATMENT FACILITY FLOW (MGD) WITH STORMWATER		RECEIVING STREAM
				1990	2020		1990	2020	1990	2020	1990	2020	1990	2020	1990	2020	1990	2020	
9	Gurnee	AB	S	100.1	181.4	229.1	311.9	507.5	91	95	1.5	2.3	100.1	181.9	54.3	91.3	76.3	137.5	Des Plaines
29	Des Plaines	AB	S	88.8	119.3	100.2	228.4	299.5	96	98	2.4	3.1	80.7	119.3	31.4	49.1	56.5	84.8	Des Plaines
10	O Hare	AB	S	108.9	136.0	80.6	325.7	361.3	100	100	4.0	4.5	108.9	136.0	61.7	79.8	85.7	108.4	Des Plaines
2	Salt Creek	AB	S	87.0	101.9	76.8	276.3	287.6	100	100	3.6	3.7	77.3	101.9	48.6	53.2	63.2	78.0	Salt Creek
33 34	Addison	AB	S	119.8	138.9	48.7	216.1	264.6	100	100	4.4	5.4	119.8	138.9	32.6	46.9	76.9	93.7	Salt Creek
11	Hinsdale	AB	S	79.2	84.6	24.6	108.5	114.8	100	100	4.4	4.7	60.9	65.1	15.1	19.3	38.4	42.6	Flagg Creek
3	North Side	AB	U	477.4	535.8	139.7	1458.6	1498.6	100	100	10.4	10.7	477.4	535.8	392.8	432.2	402.8	444.3	North Shore Channel
4	West Southwest	AB	U	1188.9	1307.1	264.3	2651.9	2786.2	100	100	10.0	10.5	1188.9	1307.1	936.6	1012.5	950.0	1033.0	Sanitary & Ship Canal
15	Hammond	AB	U	286.0	216.9	78.2	268.9	329.2	100	100	3.4	4.2	286.0	216.9	253.8	178.9	264.0	192.0	Grand Calumet
7	Calumet	AB	U	551.3	657.1	285.0	1317.9	1474.1	100	100	4.6	5.2	551.3	657.1	419.3	484.8	430.0	497.1	Little Calumet
14	Bloom	AB	U	108.3	161.5	112.2	209.5	294.8	98	98	1.9	2.7	108.3	161.5	51.1	71.2	80.2	117.0	Thorn Creek
6	Joliet	AB	U	151.0	305.7	389.6	315.3	704.0	87	96	0.9	1.9	151.0	305.7	84.0	147.9	118.0	228.0	Des Plaines
39	West Chicago	AB	S	87.2	138.7	127.4	233.6	466.8	96	100	1.9	3.7	77.7	138.7	32.7	[illegible]5.3	55.6	107.5	West Branch Du Page R
41	Downers Grove	AB	S	116.3	164.7	158.7	360.9	510.2	97	100	2.4	3.2	116.3	164.7	51.2	83.1	84.3	124.6	St Joseph Cr
8	Gary	AB	U	165.4	204.6	198.3	335.1	481.8	93	97	1.8	2.5	165.4	204.6	136.9	158.7	142.7	173.4	Grand Calumet
16	Burns Ditch	AB	S	84.0	162.8	183.6	107.0	374.0	68	89	0.9	2.3	63.6	162.8	50.4	113.4	57.2	138.5	Little Calumet
17	Michigan City	AB	U	57.2	69.7	90.6	57.0	91.0	88	75	0.7	1.3	26.0	41.0	10.1	17.8	18.2	29.6	Trail Creek

[1]AB - Advanced Biological Treatment.

[2]Land use consistent with existing regional plans.
U - Urban
S - Suburban



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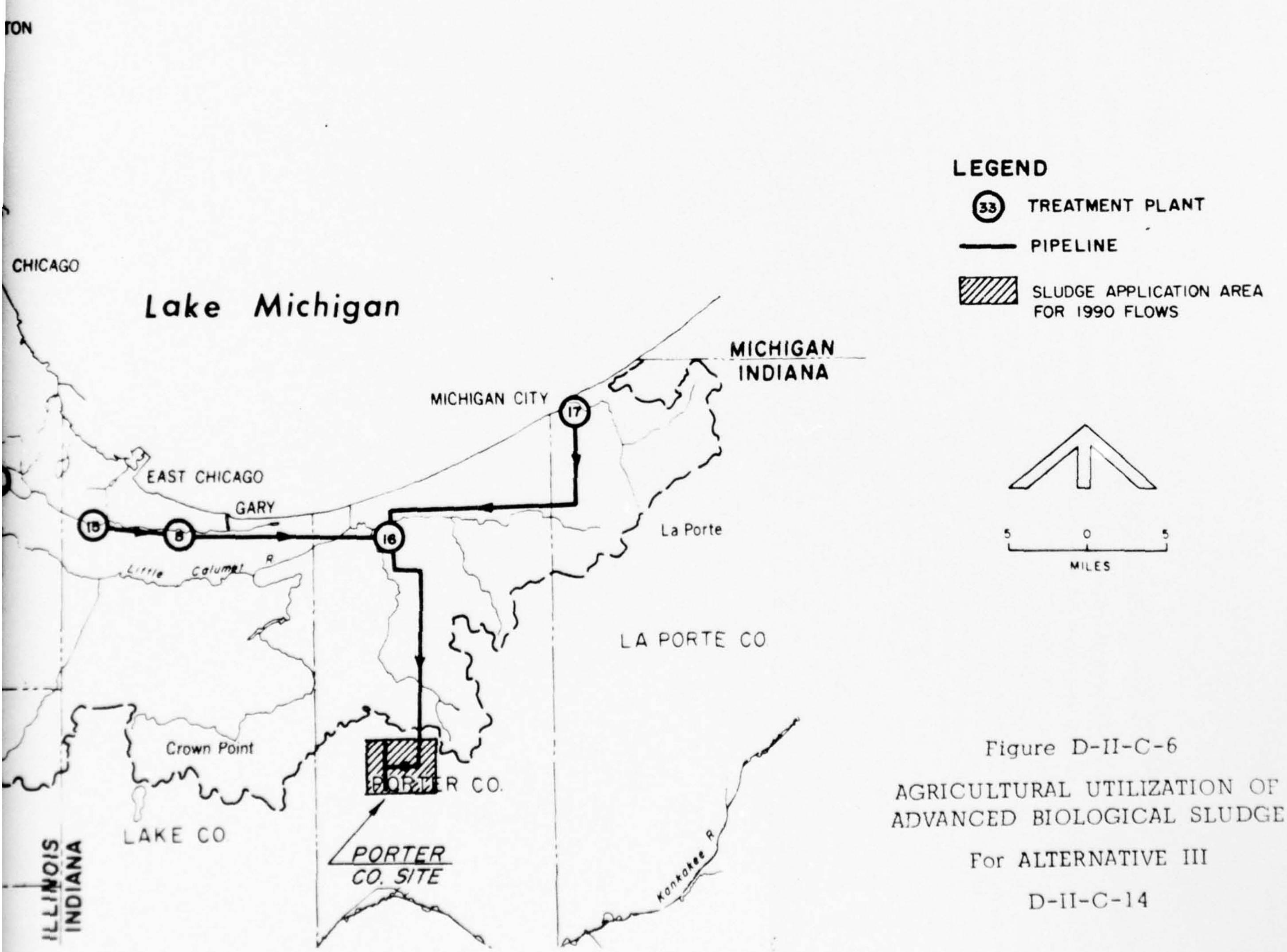


Figure D-II-C-6

AGRICULTURAL UTILIZATION OF ADVANCED BIOLOGICAL SLUDGE

For ALTERNATIVE III

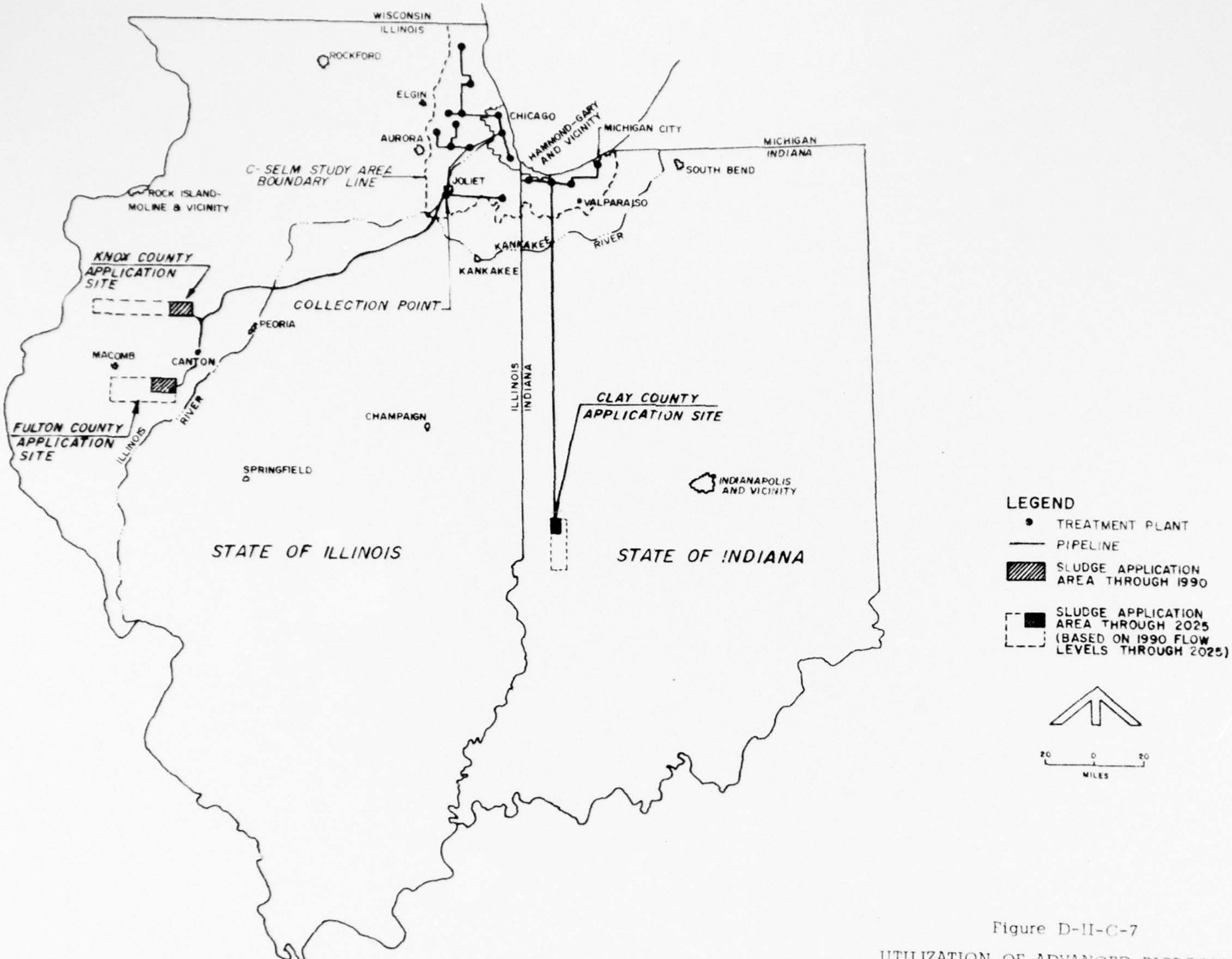


Figure D-II-C-7

UTILIZATION OF ADVANCED BIOLOGICAL SLUDGE FOR LAND RECLAMATION

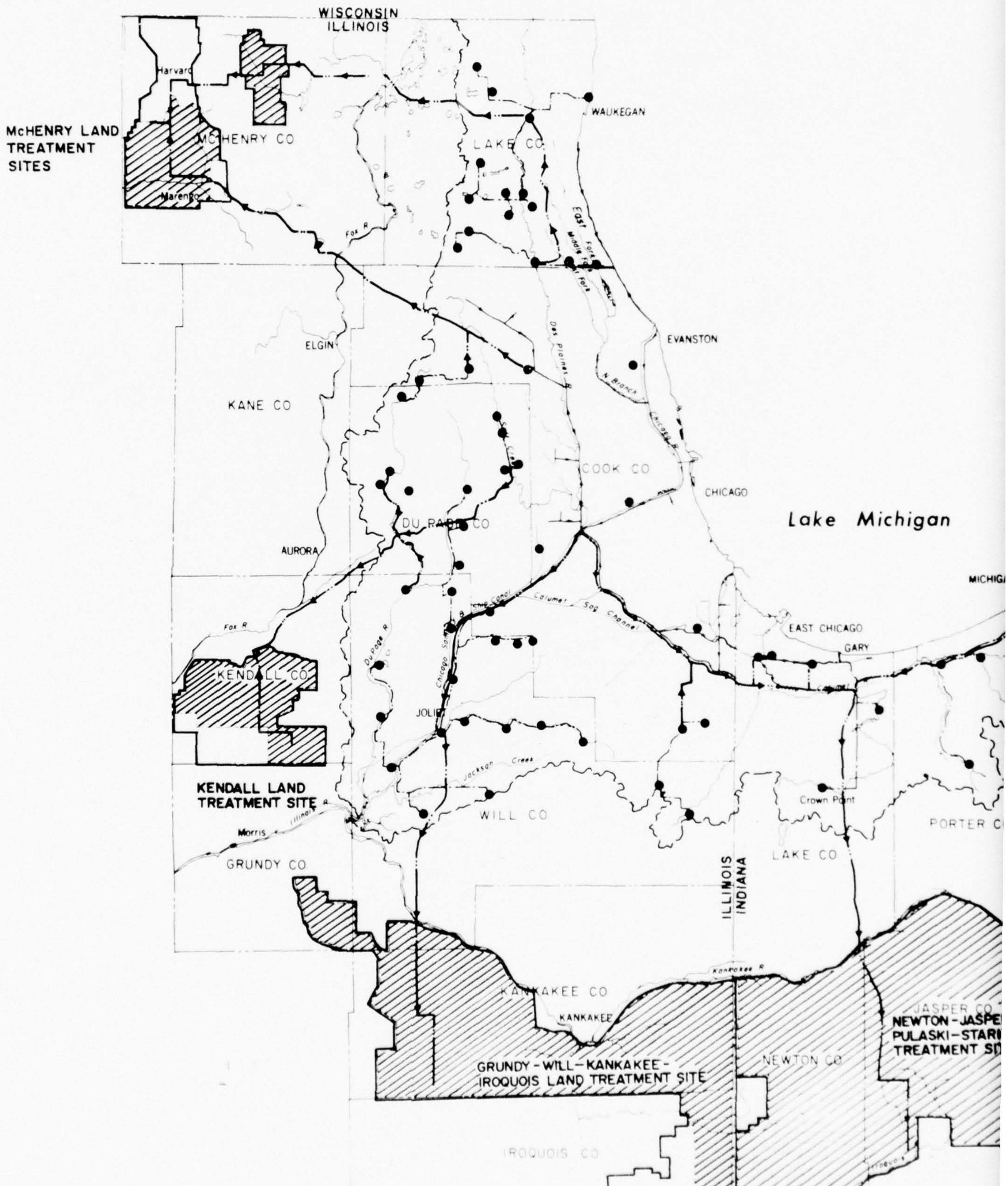
For ALTERNATIVE III

ALTERNATIVE IV - LAND TREATMENT PLAN

The land treatment technology is utilized in Alternative IV for the attainment of the NDCP water quality goals. As shown in Figure D-II-C-8, the plan consists of 5 major land sites located on the suitable agricultural land which is outside of the C-SELM study area. Detailed soil maps which were utilized in the design of these land sites are presented in Data Annex D, Section II-C. The land treatment site design information is presented in Table D-II-C-4. The conveyance system connects the 64 wastewater access points (same location as the 64 plants in Alternative I) with the land treatment conveyance system as shown in Figure D-II-C-8. The profiles for the land treatment conveyance tunnels and the reclaimed water reuse tunnels are presented in Data Annex D, Section II-C. Similar to Alternative III, the sludge management system for this plan utilizes two disposal options. In the first option, the sludge, after being stabilized in the land treatment site storage lagoons for a period of some ten years, is dredged out and conveyed via pipeline to adjacent agricultural sludge utilization areas. These agricultural sludge utilization areas are graphically presented in Figure D-II-C-9. The second sludge management option includes dredging and pipeline conveyance of the sludge from the storage lagoons to land reclamation sites in the same general vicinity as proposed in Alternative III. This sludge management utilization option is presented in Figure D-II-C-10.

ALTERNATIVE V - ADVANCED BIOLOGICAL LAND TREATMENT COMBINATION PLAN

Alternative V employs both the advanced biological and land treatment technologies to meet the NDCP water quality goal. As shown in Figure D-II-C-11, the three large secondary facilities of the MSDGC are incorporated into this plan together with the Hammond and Gary plants in Indiana for advanced waste treatment by the advanced biological technology. The remaining flows in the C-SELM area are conveyed and treated at five land treatment sites as depicted in Figure D-II-C-11. The pertinent treatment facility design information is presented in Table D-II-C-5. Similar to Alternatives III and IV, the sludge management system for this plan incorporates two sludge disposal options. For the first option, the stabilized sludge from the advanced biological plants is conveyed via pipeline to agricultural utilization areas in Will County, Illinois and Porter County, Indiana and the stabilized sludge from the land treatment storage lagoons is dredged and transmitted to adjacent agricultural sludge utilization areas as depicted in Figure D-II-C-12.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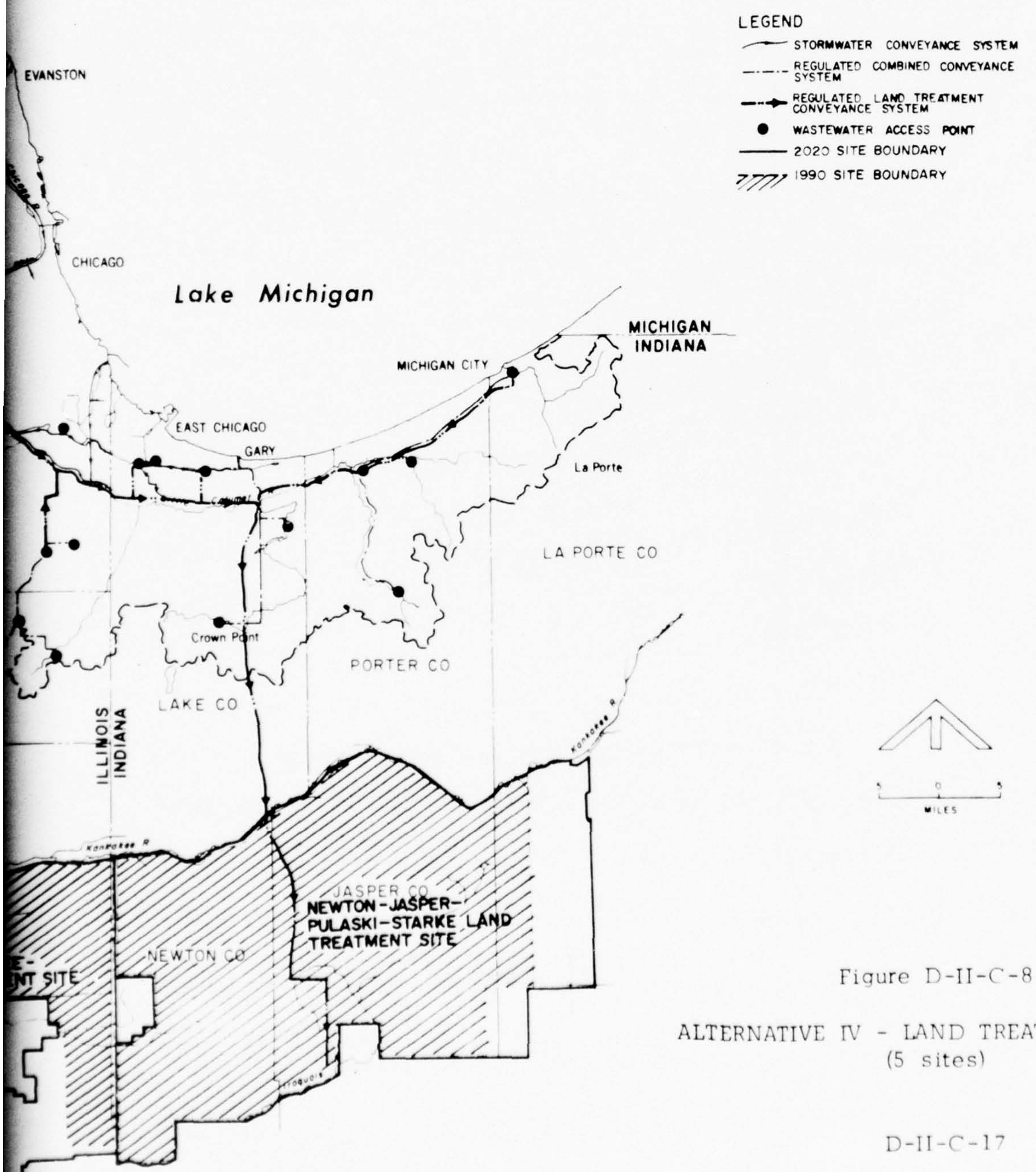


Figure D-II-C-8

ALTERNATIVE IV - LAND TREATMENT PLAN
(5 sites)

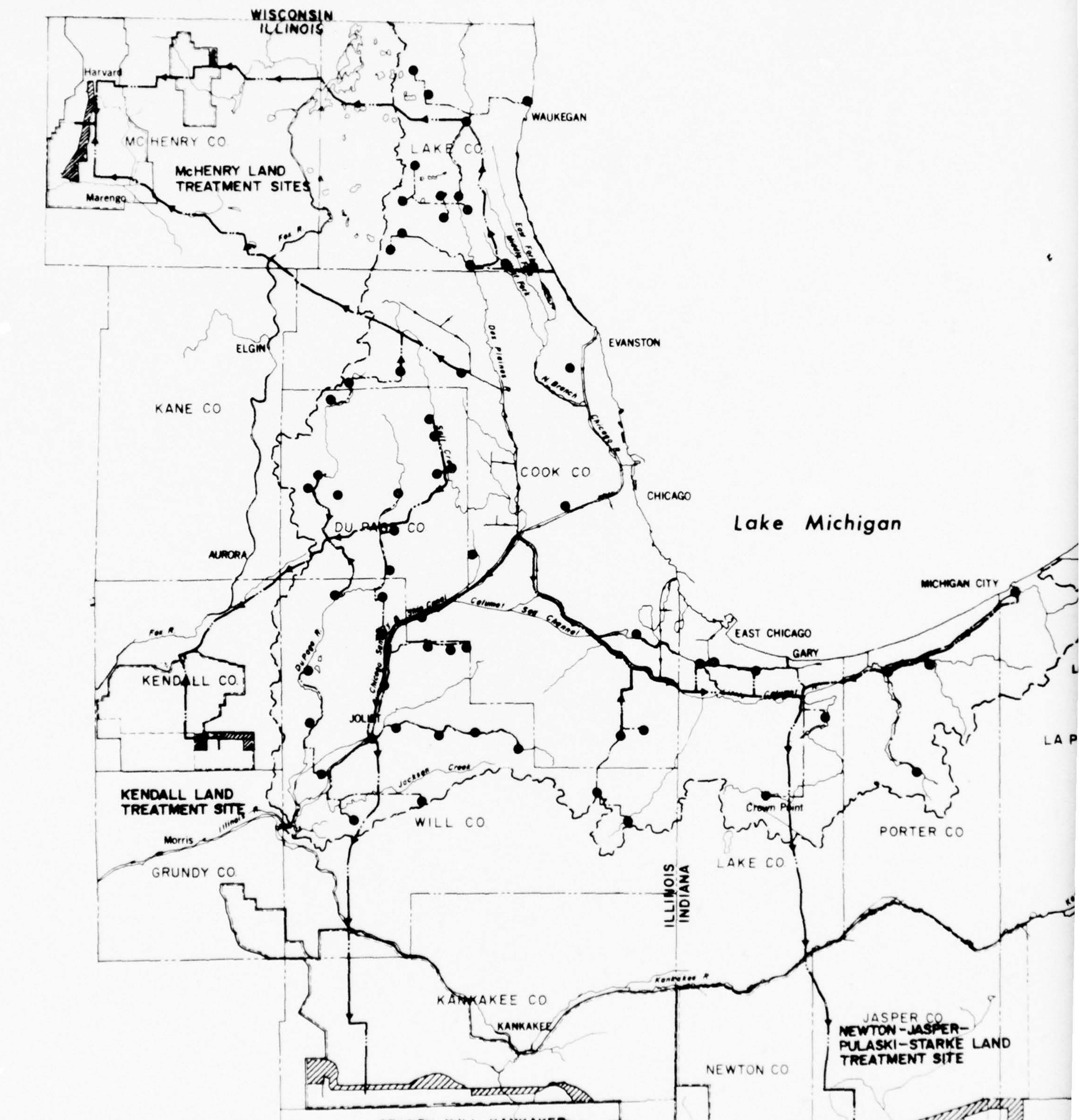
Table D-II-C-4

TREATMENT FACILITY INFORMATION FOR ALTERNATIVE IV

MAP REF NO	NAME	TYPE OF TREATMENT[1]	LAND USE[2]	TREATMENT FACILITY (ACRES) 1990 Purch	TREATMENT FACILITY (ACRES) 1990 Lease	TREATMENT FACILITY (ACRES) 2020 Purch	TREATMENT FACILITY (ACRES) 2020 Lease	SERVICE AREA (SQ MI)	POPULATION SERVED (1000'S) 1990	POPULATION SERVED (1000'S) 2020	PERCENT POPULATION SERVED IN SERVICE AREA 1990	PERCENT POPULATION SERVED IN SERVICE AREA 2020	POPULATION DENSITY PEOPLE x 10^3 PER SQ MILE 1990	POPULATION DENSITY PEOPLE x 10^3 PER SQ MILE 2020	TREATMENT FACILITY CAPACITY IN M.G.D. 1990	TREATMENT FACILITY CAPACITY IN M.G.D. 2020	AVERAGE TREATMENT FACILITY FLOW (MGD) WITHOUT STORMWATER 1990	AVERAGE TREATMENT FACILITY FLOW (MGD) WITHOUT STORMWATER 2020	AVERAGE TREATMENT FACILITY FLOW (MGD) WITH STORMWATER 1990	AVERAGE TREATMENT FACILITY FLOW (MGD) WITH STORMWATER 2020	RECEIVING STREAM
	McHenry West	LT	R	4,300	20,300	7,000	33,000	369.7	821.4	1169.2	98	98	2.9	3.2	264.1	435.1	141.0	220.6	202.7	329.7	North Shore Channel, Des Plaines R. San.C.
	McHenry Central	LT	R	1,700	7,900	1,700	7,900	117.0	320.9	286.7	93	96	1.8	2.6	102.9	104.0	55.0	52.8	79.0	79.0	Des Plaines River
	Kendall	LT	R	4,600	21,700	6,800	32,600	334.8	810.6	1241.6	97	100	2.5	3.7	313.8	442.3	116.5	205.3	216.8	325.8	Des Plaines River
	Grundy, Will, Kankakee & Iroquois	LT	R	21,800	103,200	118,300	178,100	674.9	3195.1	3593.2	99	99	4.7	5.4	1281.4	1504.9	955.5	1063.0	1032.3	1188.0	Sanitary & Ship Canal
	Newton, Jasper, Pulaski & Starke	LT	R	31,000	146,700	170,700	256,300	1091.2	3634.6	4555.3	96	98	3.5	4.3	1797.4	2152.7	1394.6	1573.7	1469.2	1707.5	Lake Michigan & Cal Sag Channel

[1]LT - Land Treatment.

[2]Land use consistent with existing regional plans.
R - Rural



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KANKAKEE
JASPER CO
NEWTON-JASPER-PULASKI-STARKE LAND TREATMENT SITE
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GRUNDY-WILL-KANKAKEE-IROQUOIS LAND TREATMENT SITE
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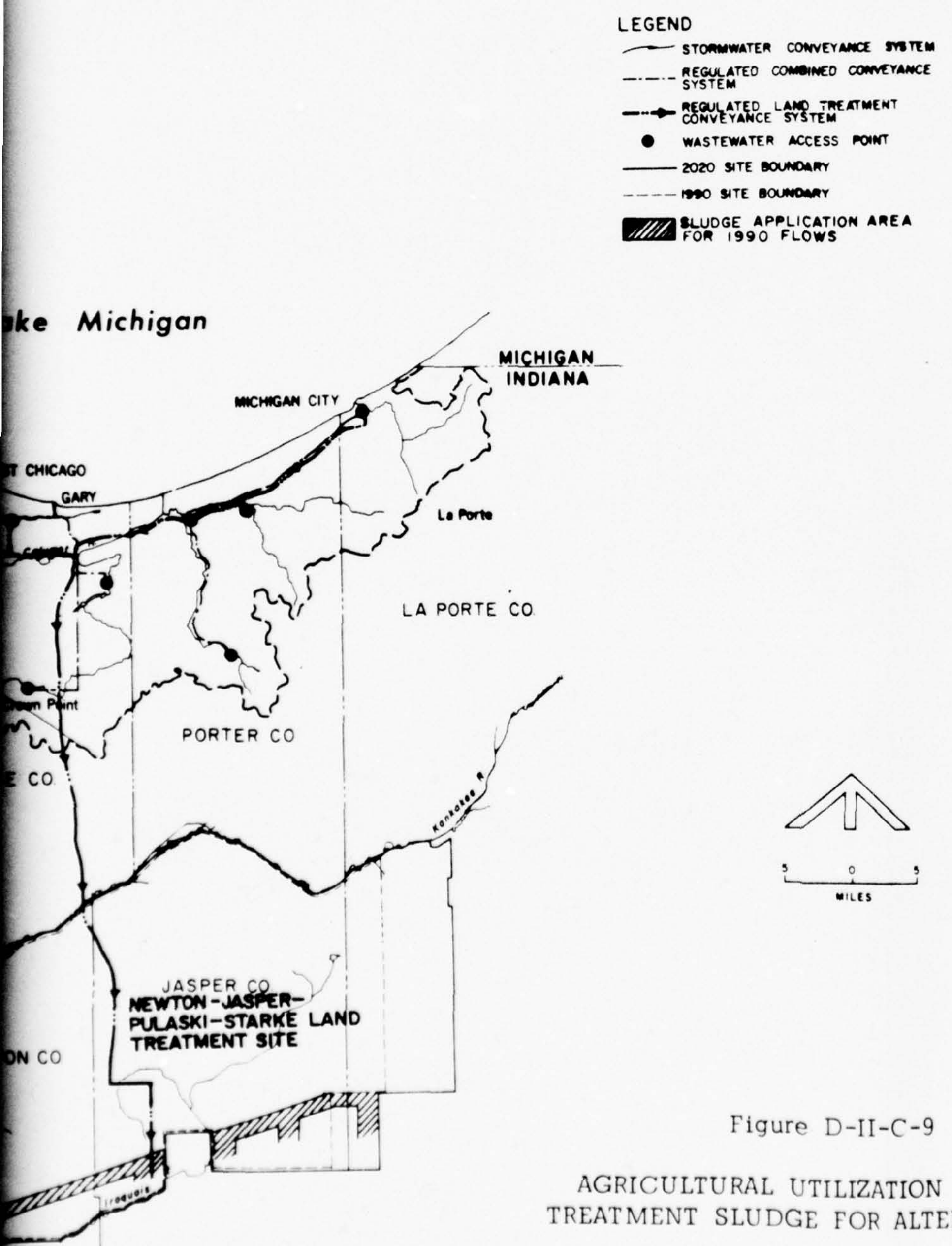


Figure D-II-C-9

AGRICULTURAL UTILIZATION OF LAND TREATMENT SLUDGE FOR ALTERNATIVE IV

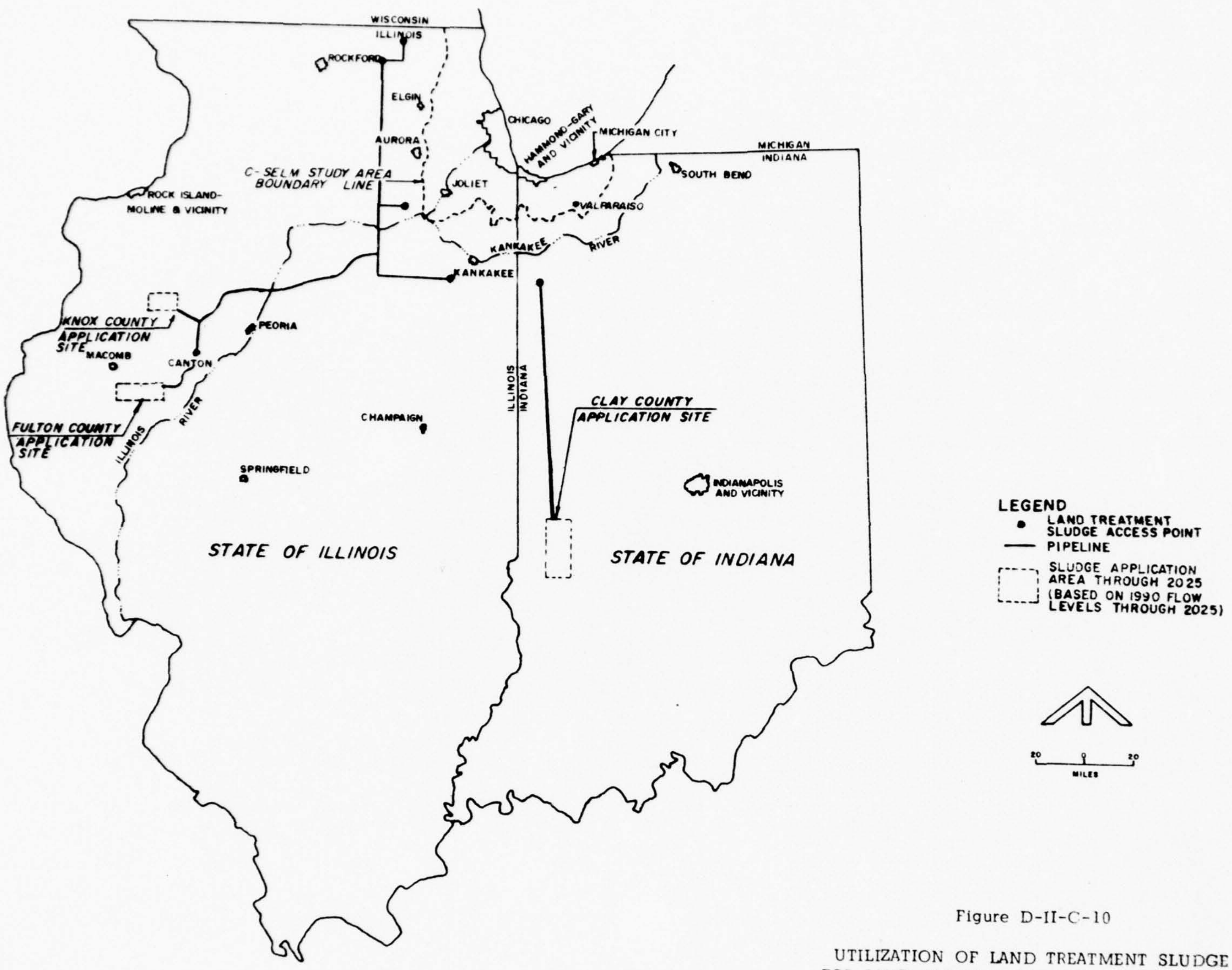
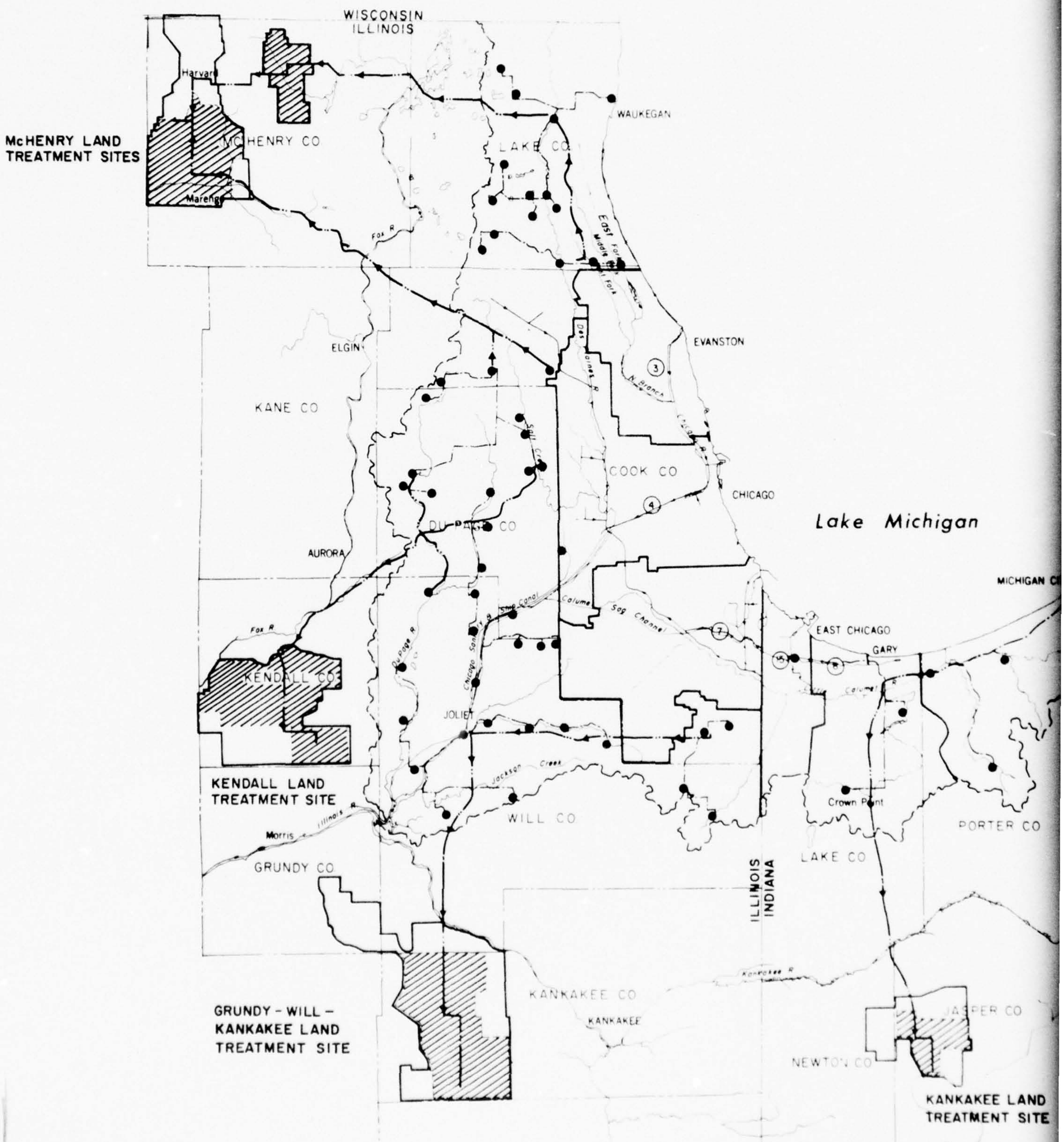


Figure D-II-C-10

UTILIZATION OF LAND TREATMENT SLUDGE
FOR LAND RECLAMATION FOR ALTERNATIVE IV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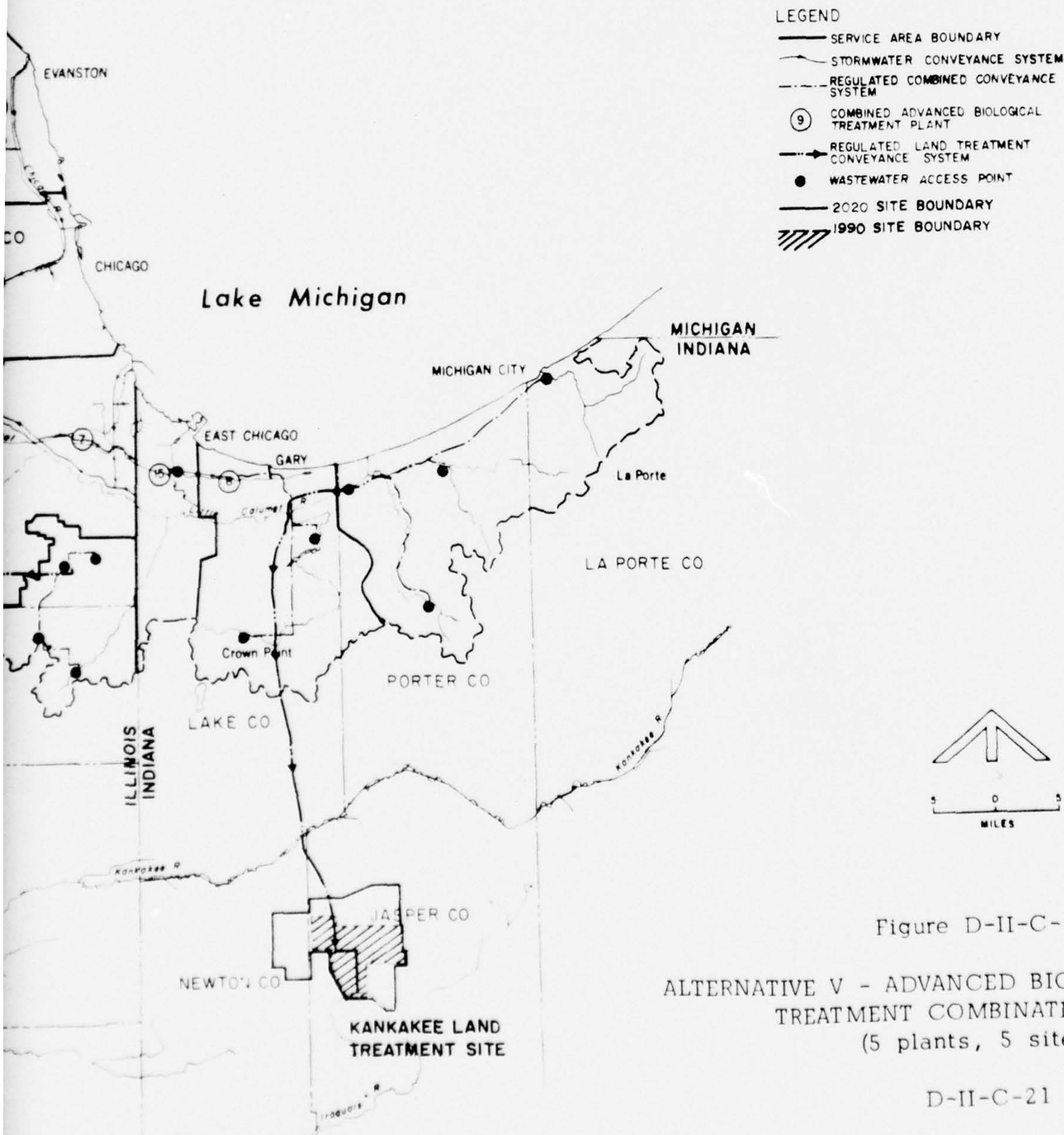


Figure D-II-C-11

ALTERNATIVE V - ADVANCED BIOLOGICAL - LAND TREATMENT COMBINATION PLAN
(5 plants, 5 sites)

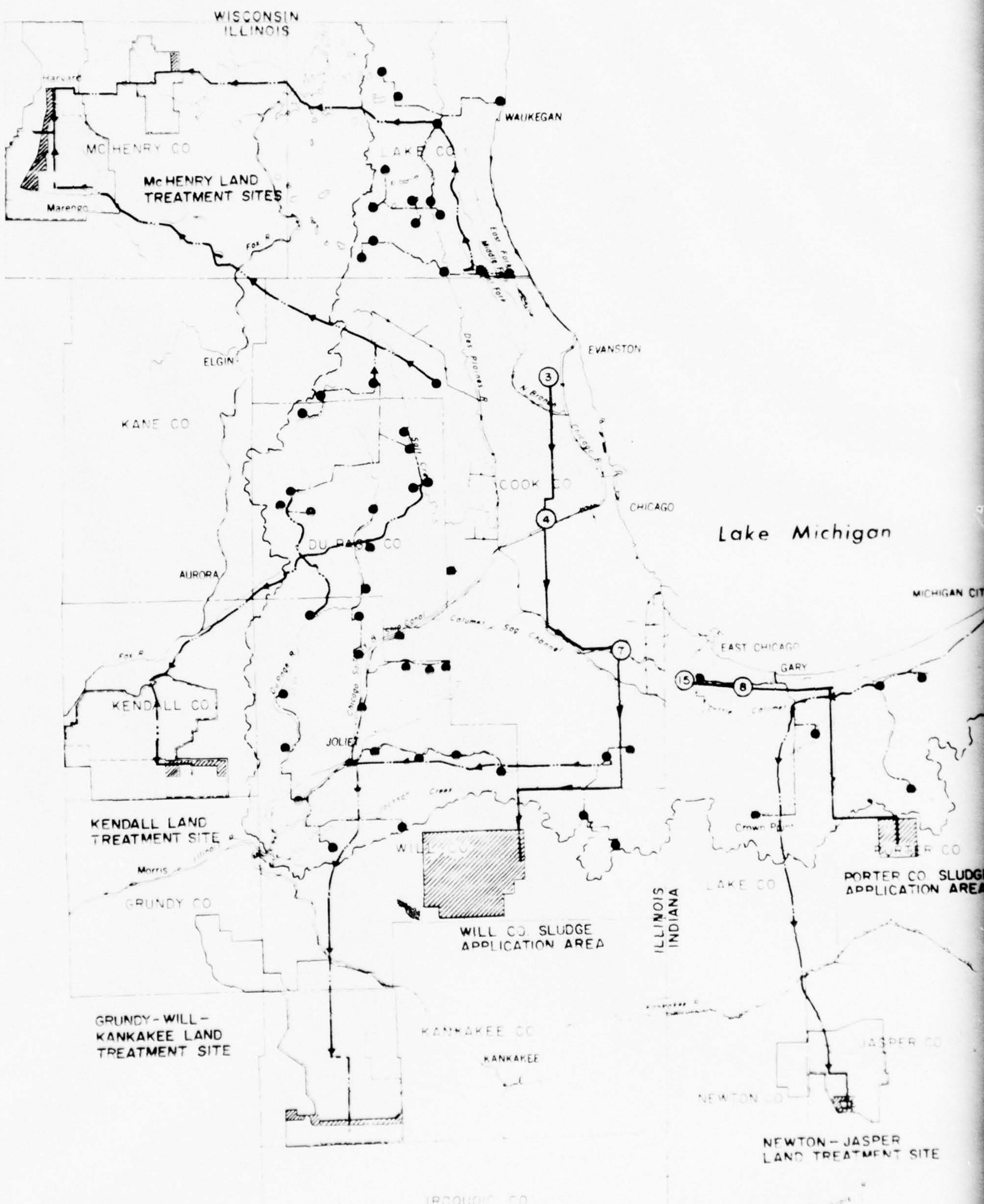
Table D-II-C-5

TREATMENT FACILITY INFORMATION FOR ALTERNATIVE V

MAP REF NO	NAME	TYPE OF TREATMENT[1]	LAND USE[2]	TREATMENT FACILITY (ACRES) 1990 Purch	TREATMENT FACILITY (ACRES) 1990 Lease	TREATMENT FACILITY (ACRES) 2020 Purch.	TREATMENT FACILITY (ACRES) 2020 Lease	SERVICE AREA (SQ MI.)	POPULATION SERVED (1000'S) 1990	POPULATION SERVED (1000'S) 2020	PERCENT POPULATION SERVED IN SERVICE AREA 1990	PERCENT POPULATION SERVED IN SERVICE AREA 2020	POPULATION DENSITY PEOPLE x 10³ PER SQ MILE 1990	POPULATION DENSITY PEOPLE x 10³ PER SQ MILE 2020	TREATMENT FACILITY CAPACITY IN M.G.D. 1990	TREATMENT FACILITY CAPACITY IN M.G.D. 2020	AVERAGE TREATMENT FACILITY FLOW (MGD) WITHOUT STORMWATER 1990	AVERAGE TREATMENT FACILITY FLOW (MGD) WITHOUT STORMWATER 2020	AVERAGE TREATMENT FACILITY FLOW (MGD) WITH STORMWATER 1990	AVERAGE TREATMENT FACILITY FLOW (MGD) WITH STORMWATER 2020	RECEIVING STREAM
3	North Side	AB	U	477.4	-	535.8	-	199.7	1458.6	1498.6	100	100	10.4	10.7	477.4	535.8	392.8	432.2	402.8	444.3	North Shore Channel
4	West-Southwest	AB	U	1188.9	-	1307.1	-	264.3	2651.9	2786.2	100	100	10.0	10.5	1188.9	1307.1	936.6	1012.5	950.0	1033.0	Sanitary & Ship Canal
15	Hammond	AB	U	286.0	-	216.9	-	78.2	268.9	329.2	100	100	3.4	4.2	286.0	216.9	253.8	178.9	264.0	192.0	Grand Calumet
7	Calumet	AB	U	551.3	-	657.1	-	286.0	1317.9	1474.1	100	100	4.6	5.2	551.3	657.1	419.3	484.8	430.0	497.1	Little Calumet
8	Gary	AB	U	165.4	-	204.6	-	198.3	335.1	481.8	93	97	1.8	2.5	165.4	204.6	136.9	158.7	142.7	173.4	Grand Calumet
	McHenry West	LT	R	4,300	20,300	7,000	33,000	369.7	821.4	1169.2	98	98	2.9	3.2	264.1	435.1	141.0	220.6	202.7	329.7	Fox River
	McHenry Central	LT	R	1,700	7,900	1,700	7,900	117.0	320.9	286.7	93	96	1.8	2.6	102.9	104.0	55.0	52.8	79.0	79.0	Fox River
	Kendall	LT	R	4,600	21,700	6,800	32,600	334.8	810.6	1241.6	97	100	2.5	3.7	313.8	442.3	116.5	205.3	216.8	325.8	Fox River
	Grundy-Will-Kankakee	LT	R	5,000	23,700	8,200	38,800	526.4	633.3	1113.6	92	97	1.3	2.2	320.2	532.3	150.2	238.4	236.6	387.6	Illinois River
	Newton Jasper	LT	R	1,600	7,500	3,600	16,800	274.2	164.0	465.0	74	85	0.8	2.0	89.6	203.8	60.5	131.2	75.4	168.1	Kankakee R

[1] AB - Advanced Biological Treatment.
LT - Land Treatment.

[2] Land use consistent with existing regional plans
U - Urban
R - Rural


WISCONSIN
ILLINOIS
Harvard
McHENRY CO
LAKE CO
WAUKEGAN
McHENRY LAND
TREATMENT SITES
Marengo
Fox R.
EVANSTON
ELGIN
KANE CO
COOK CO
CHICAGO
Lake Michigan
DU PAGE CO
AURORA
MICHIGAN CITY
Calumet Sag Channel
EAST CHICAGO
GARY
Fox R.
KENDALL CO
JOLIET
Crown Point
KENDALL LAND
TREATMENT SITE
Morris
WILL CO
PORTER CO
PORTER CO. SLUDGE
APPLICATION AREA
LAKE CO
ILLINOIS
INDIANA
GRUNDY CO
WILL CO. SLUDGE
APPLICATION AREA
GRUNDY-WILL-
KANKAKEE LAND
TREATMENT SITE
KANKAKEE CO
KANKAKEE
JASPER CO
NEWTON CO
NEWTON-JASPER
LAND TREATMENT SITE
IROQUOIS CO
3
4
7
8
15

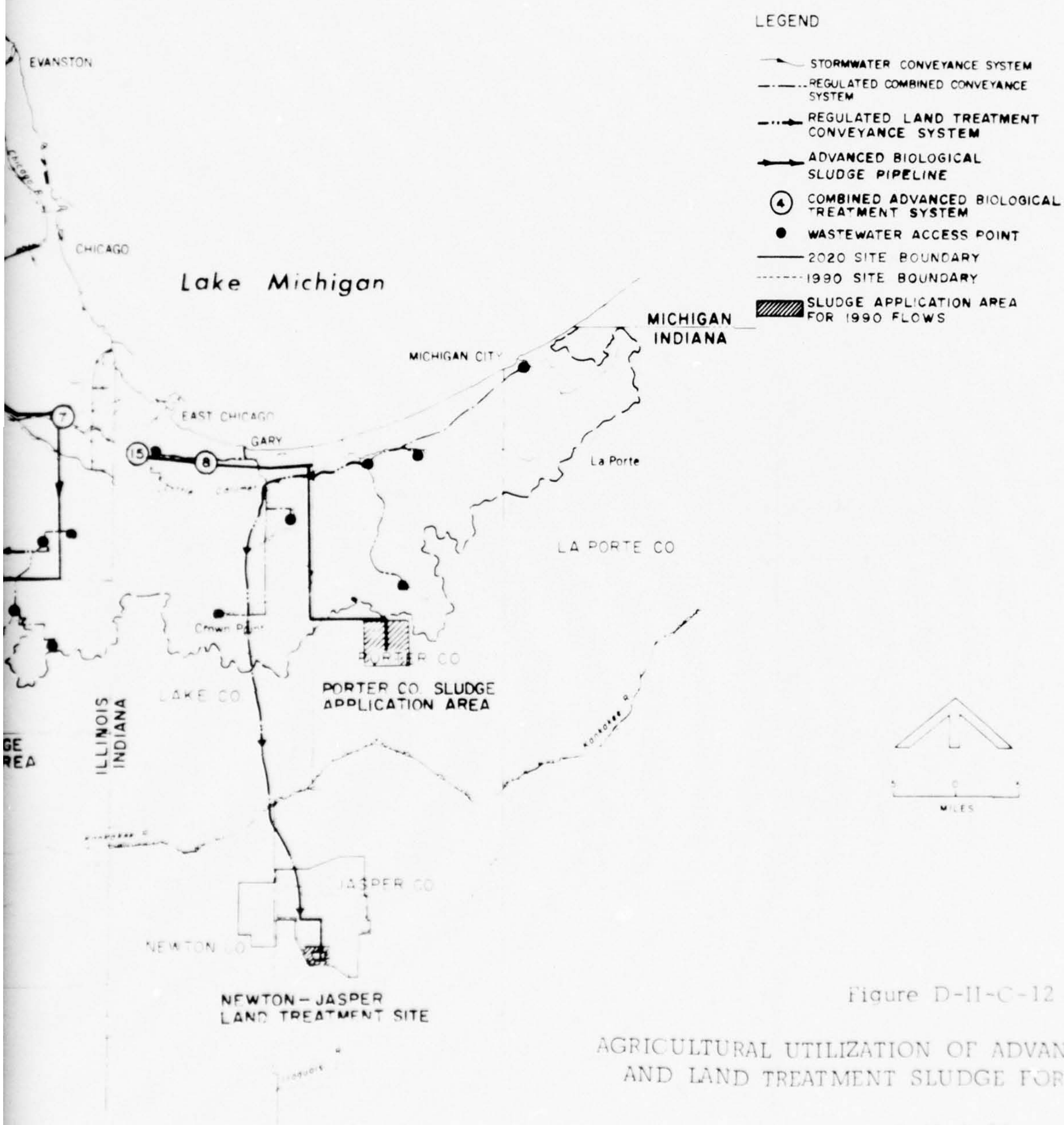


Figure D-II-C-12

AGRICULTURAL UTILIZATION OF ADVANCED BIOLOGICAL AND LAND TREATMENT SLUDGE FOR ALTERNATIVE V

The second sludge management option includes the pipeline conveyance of stabilized advanced biological and land treatment sludge to strip-mined areas in Illinois and Indiana as graphically presented in Figure D-II-C-13. In these areas large one-time applications of sludge are made for the purpose of reclaiming this barren land for more productive use.

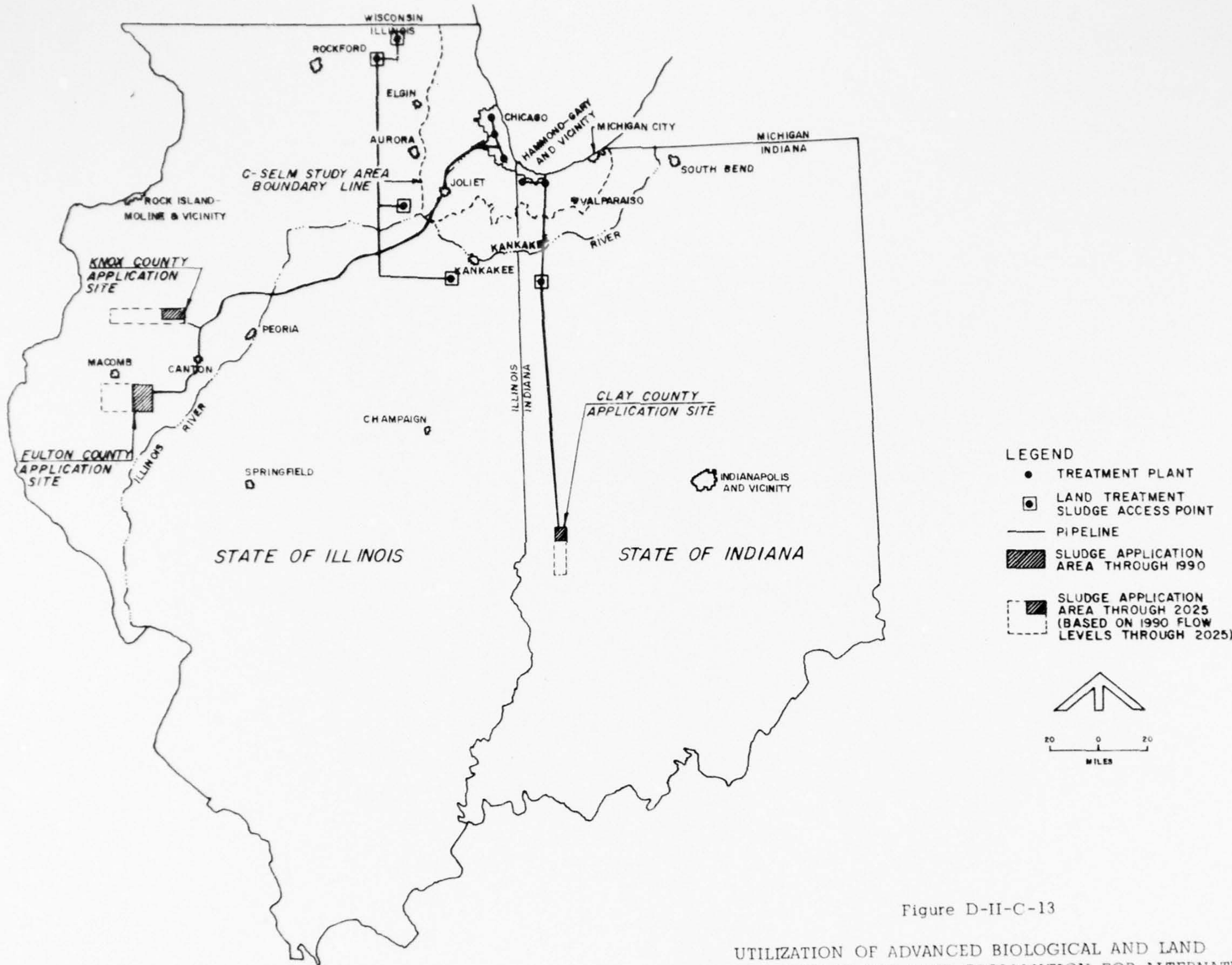


Figure D-II-C-13

UTILIZATION OF ADVANCED BIOLOGICAL AND LAND TREATMENT SLUDGE FOR LAND RECLAMATION FOR ALTERNATIVE V

TECHNICAL APPENDIX D

III. PHASING AND IMPLEMENTATION

III. PHASING AND IMPLEMENTATION

A. INTRODUCTION

PURPOSE

Each of the wastewater management alternatives, developed as a result of the C-SELM Study, is composed of many, not presently constructed, systems and sub-systems. The implementation of any one alternative will require a large number of properly sequenced construction periods with related construction costs. Further, as construction of systems or portions of systems are completed they can be placed in operation with appropriate beginning of expenditure of operation and maintenance (O & M) and replacement funds. The purpose of this section of the Appenaix is to develop a construction and start-up program for each of the alternatives which is both logical and practical and which is compatable with the priorities and policies for C-SELM wastewater management. Finally, the structuring of those construction and start-up or phasing and implementation programs for the alternatives will facilitate the examination of comparative economic costs associated with their respective implementation, which takes place in Section IV, the next section of this Appendix.

ORGANIZATION

This section is organized into subsections entitled Introduction, Priorities and Policies, Procedure, Construction Cost and Start-up Programs by System and Construction Cost and Start-up Program Summary. The Introduction presents the purpose for a Phasing and Implementation program and outlines the organization or format of this phasing and implementation section. The Priorities and Policies subsection lists the controls applicable to C-SELM wastewater management which largely determine the design of the phasing and implementation program. The procedure subsection describes the basis and constraints for the phasing and implementation programs. Finally, the Construction Cost and Start-up Program(s) by System and Summary subsections define the detailed and overall phasing and implementation programs, respectively, for each of the alternatives.

B. PRIORITIES AND POLICIES

The controls imposed on the phasing and implementation programs by the applicable C-SELM wastewater management priorities and policies taken together with the practicalities of construction schedules and reasonable funding schedules effectively determine implementation program design. The listing of priorities and policies which follows largely provides this program definition.

(1) NDCP water quality goals achieved by 1985 consistent with the new and prevailing federal water quality legislation of 1972.

(2) Minimum exposure of premature investment to maximize protection against avoidable obsolescence.

(3) Maximum protection of Lake Michigan water quality.

(4) Early prototype development in order to optimize subsequent designs.

(5) Combined sewer service areas given construction priority for stormwater management consistent with the 1972 federal water quality legislation.

(6) Flood control aspects of stormwater management given construction and start-up priority over water quality aspects.

(7) Water quality aspects of stormwater management implementation coincident with implementation of NDCP treatment of municipal and industrial (M & I) flows.

(8) Soil erosion controlled by application of Soil Conservation Service (SCS) practices in rural and outer suburban C-SELM areas prior to other stormwater management implementation.

(9) Utilization of stormwater conveyance and storage as it becomes available during the construction period for equalization of M & I diurnal and stormwater peak flows prior to treatment in existing secondary treatment facilities, thus obtaining more effective treatment with existing treatment capacity.

(10) Construction program commences on January 1, 1975.

C. PROCEDURE

BASIS

The phasing and implementation programs described in this section apply only to the new treatment systems envisioned in the already described C-SELM Alternatives I through V. Existing wastewater management systems are assumed either to phase into the newly implementing systems such as in Alternative I, the Reference alternative which utilizes a large amount of existing facilities or to phase out with the newly implementing systems such as in Alternative II, the Physical-Chemical technology alternative which requires essentially all new facilities.

The construction costs incurred during implementation for the various alternatives are the costs required to introduce or supplement the capacity of systems to the year 1990 design flows. When the newly constructed systems are placed in operation the O&M and replacement costs appropriate to those systems commence. Existing systems, which are either supplemented or supplanted upon start-up of the newly implemented alternative or its component systems are not prior costed for either O&M or replacement. Thus, the phasing and implementation programs together with their associated costs are only applicable to the newly implemented alternatives and all costs associated with existing wastewater management are ignored until this management is either supplemented or supplanted.

CONSTRAINTS

Two constraints are imposed on the phasing and implementation programs in order to facilitate the comparison of impacts caused by the various alternatives and to maintain a degree of detail appropriate to a survey-scope type study. First, the construction schedule and the start-up schedule for a given system are identical for all alternatives and are specified by percentage of total construction capital expended versus time and by percentage of 1990 capacity placed in operation versus time, respectively. Second, the percentage of total construction capital expended versus time is held to a uniform rate. The above two constraints are compatible with logical implementation programs for each of the alternatives and provide, at the same time, for an effective and efficient comparison of impacts

of the alternatives.

A third constraint, or freedom from constraint in this case, is that construction capital funds are available appropriate to the phasing selected.

D. CONSTRUCTION COST AND START-UP PROGRAMS BY SYSTEM

The C-SELM phasing and implementation program is described in this subsection in detail for each system or system component. This program is consistent with the priorities and policies cited earlier for C-SELM wastewater management and with the preceding procedure constraints. The system or system component is analyzed for implementation both with and without separate sewer stormwater management. Except for transmission facilities, all system components are designed and costed for 1990 flows. The transmission facilities are designed and costed for the 2020 flows.

Stormwater Management, Phase 1
Combined Stormwater Storage

As presented in Figure D-III-D-1, the construction on capital costs associated with the stormwater management system in the C-SELM combined sewer service areas are expended at a rate of 10% per year commencing in 1975. Stormwater management for the 375 square mile MSDGC combined service area begins in 1985. This system comprises 65% of the total C-SELM combined sewer capacity. For the combined sewer portions of Lake and DuPage Counties (less Hinsdale) which is equal to 25% of the total system capacity, the stormwater management system commences in 1980. The remaining 10% of the system capacity which relates to the Hinsdale and Bloom Township areas comes on line in 1982. Stormwater management, Phase 1, applies to both with and without separate stormwater analyses.

Stormwater Management, Phase 2
SCS Practices

Phase 2 of the stormwater management system refers to the implementation of SCS practices on all rural lands based on the 1970 design year. Beginning in 1975, 16.6% of the construction capital for this phase is expended per year. As graphically presented in Figure D-III-D-2, the implementation of this system lags the construction by one year. Stormwater Management, Phase 2, applies to the with separate stormwater analysis only.

FIGURE D-III-D-1 STORMWATER MANAGEMENT SYSTEMS, PHASE I

CAPITAL EXPENDITURE & ON-LINE CAPACITY SCHEDULE

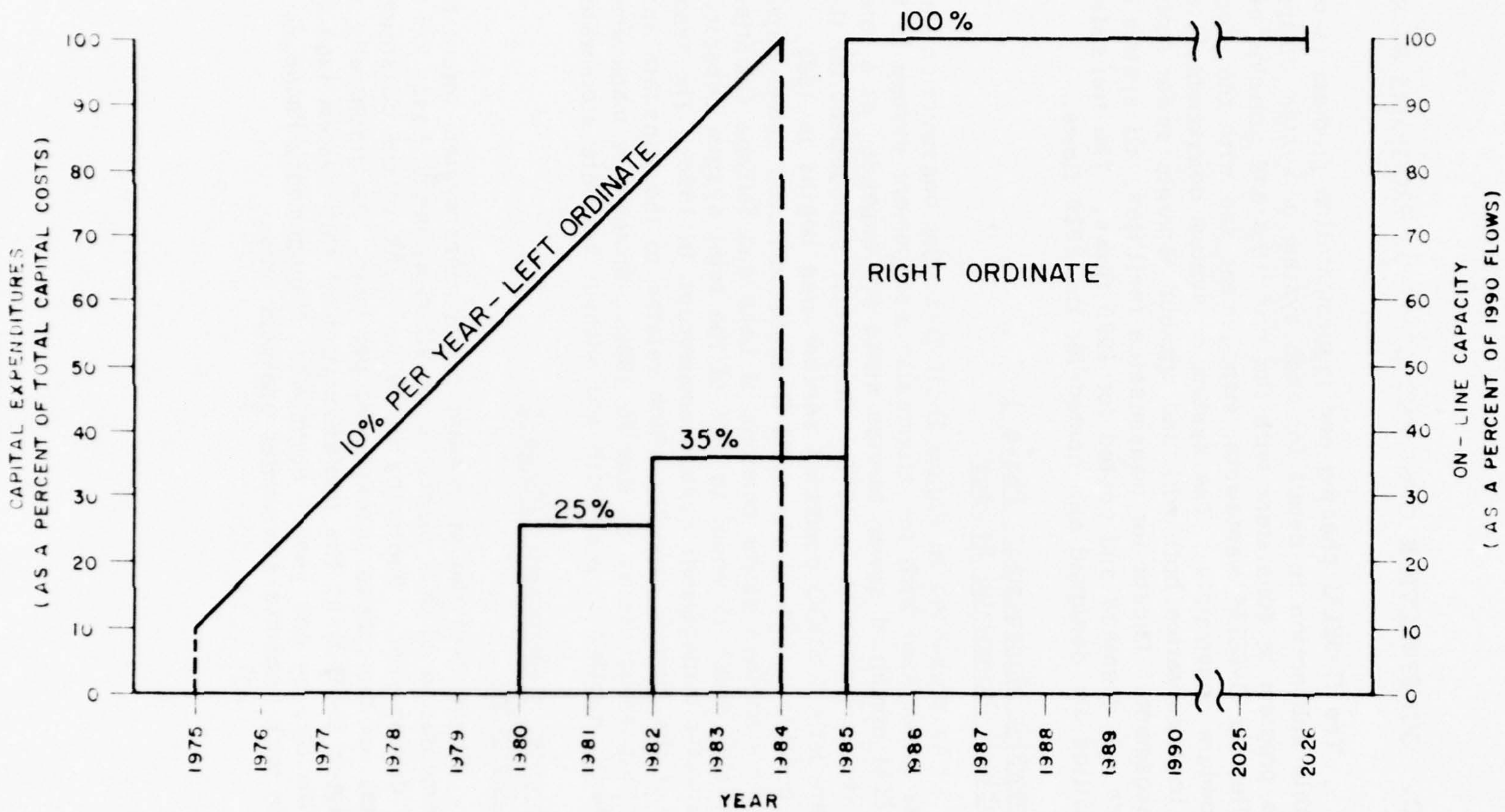
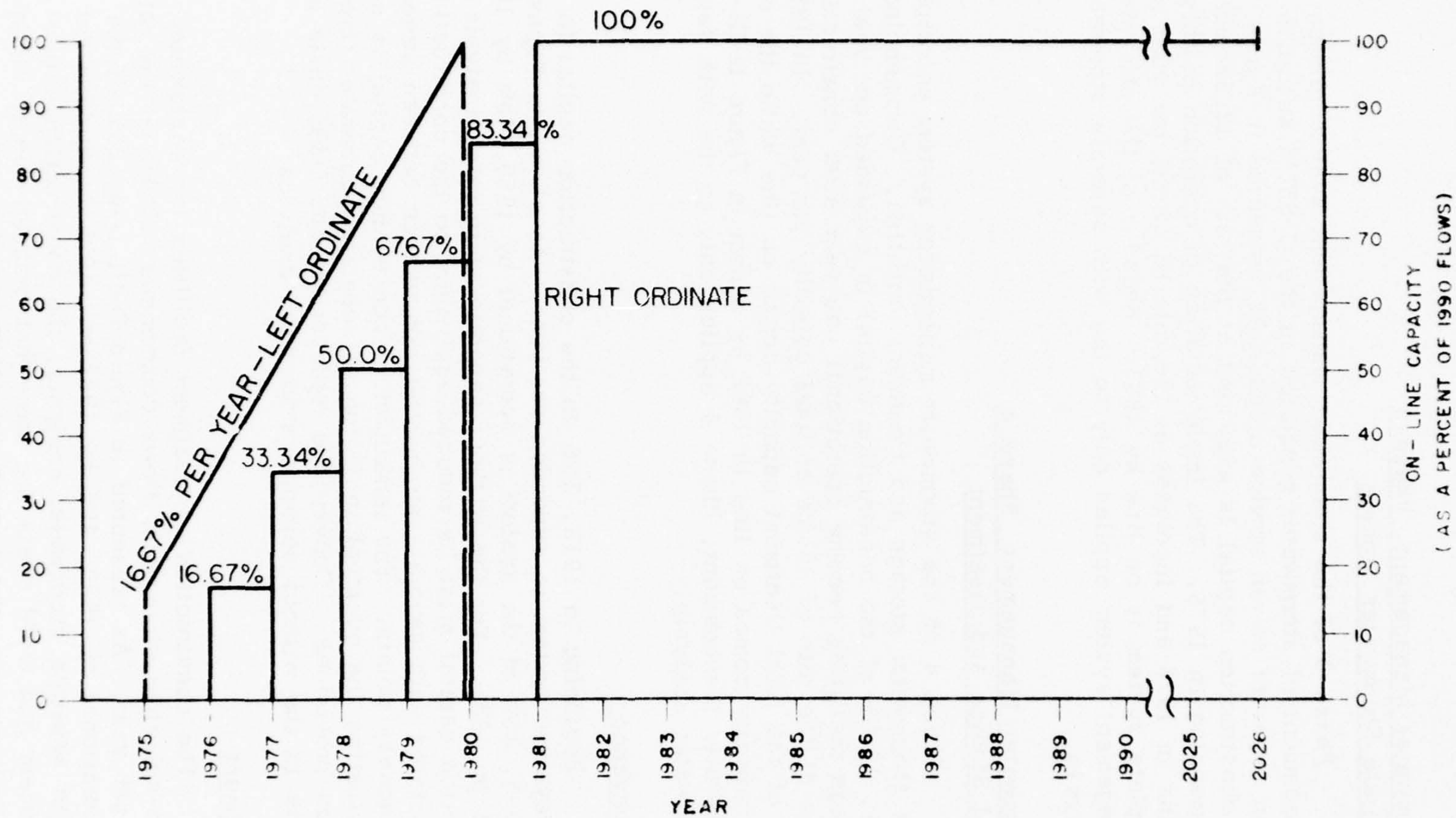


FIGURE D-III-D-2 STORMWATER MANAGEMENT SYSTEMS, PHASE II

CAPITAL EXPENDITURE & ON-LINE CAPACITY SCHEDULE



Stormwater Management, Phase 3
Separate Stormwater Storage

Phase 3 of the stormwater management system relates to management of stormwater generated in the C-SELM suburban and urban separate sewer service areas. As presented in Figure D-III-D-3, the construction capital is expended at the rate of 12.5% per year commencing in 1975. The implementation of operation of this phase begins in 1976 and increases at the rate of 12.5% per year until the complete system is on line by 1983. Phase 3 of the stormwater management system applies only to the with separate stormwater analysis.

Stormwater Management, Phase 4
Rural Storage and Treatment

Phase 4 of the stormwater management system encompasses rural stormwater storage and treatment facilities. Commencing in 1975, 12.5% of the construction capital is expended per year. The storage facilities become operational one year after construction begines at the rate of 12.5% of total capacity per year. In 1980, 55% of the rural treatment capacity comes on line while the remaining capacity comes on line in 1982 as shown in Figure D-III-D-4. Stormwater Management, Phase 4 applies only to the with separate stormwater analysis.

Conveyance

Beginning in 1975, 20% on the construction capital for the conveyance system is expended per year. As shown in Figure D-III-D-5, 25% of the system is operational by 1980, 40% by 1982 and 100% by 1985. For the without separate stormwater analysis construction capital must be reduced equivalent to the construction cost associated with separate stormwater conveyance between storages and access points. The remainder of conveyance capital is unchanged, anticipating the eventual inclusion of separate stormwater through design provisions. Conveyance replacement and O&M costs also decrease in the without separate stormwater analysis.

Treatment

The construction of treatment facilities for wastewater and urban-suburban stormwater flows commences in 1975 at the rate of 10% per year. As presented in Figure D-III-D-6, 25% of the system is operational by 1980, 40% by 1982 and 100% by 1985. For the without separate stormwater analysis, the construction capital, replacement and O&M costs are somewhat reduced due to diminished installed capacity and average annual flow.

FIGURE D-III-D-3 STORMWATER MANAGEMENT SYSTEMS, PHASE III

CAPITAL EXPENDITURE & ON-LINE CAPACITY SCHEDULE

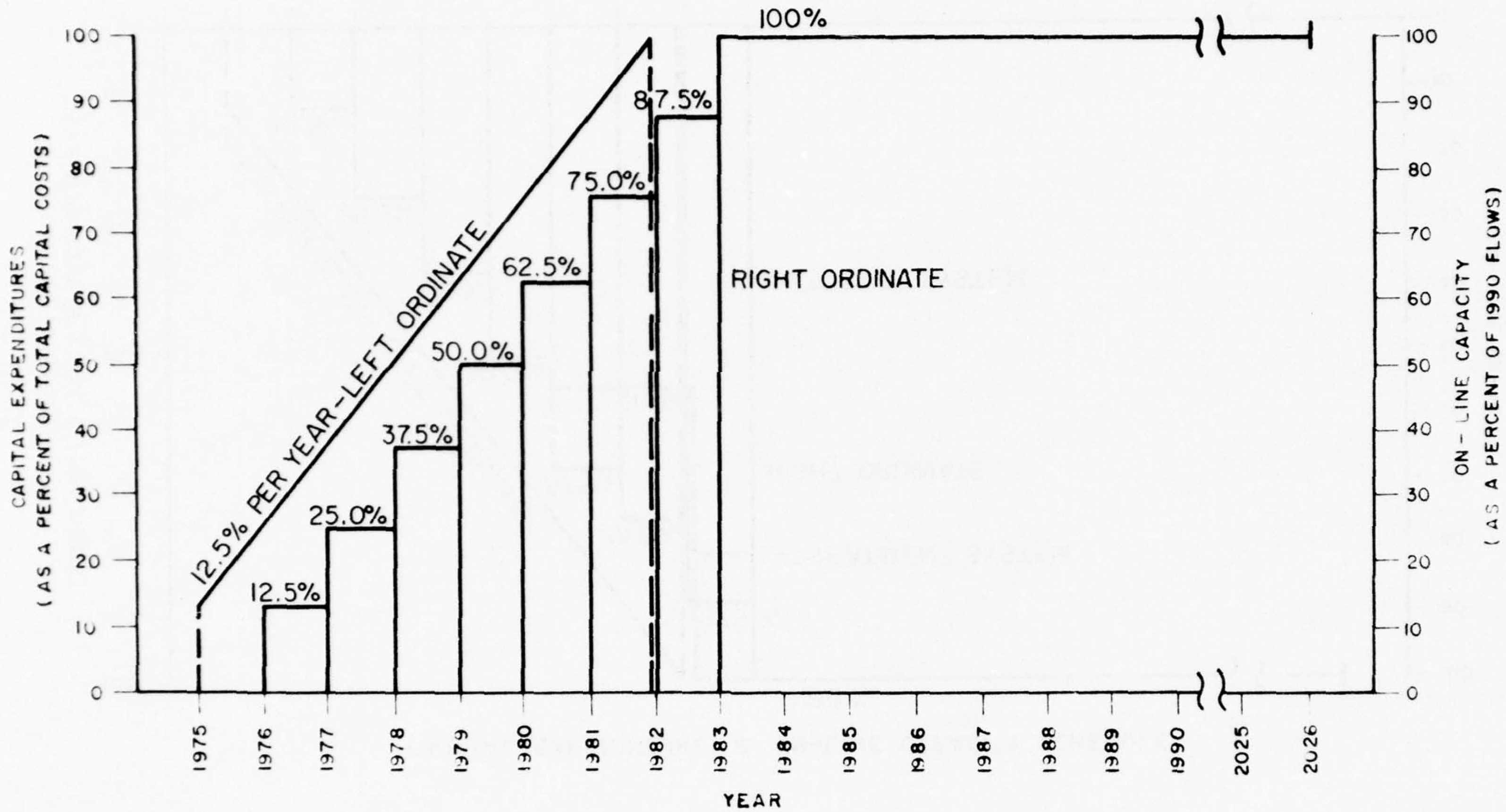


FIGURE D-III-D-4 STORMWATER MANAGEMENT SYSTEMS, PHASE IV

CAPITAL EXPENDITURE & ON-LINE CAPACITY SCHEDULE

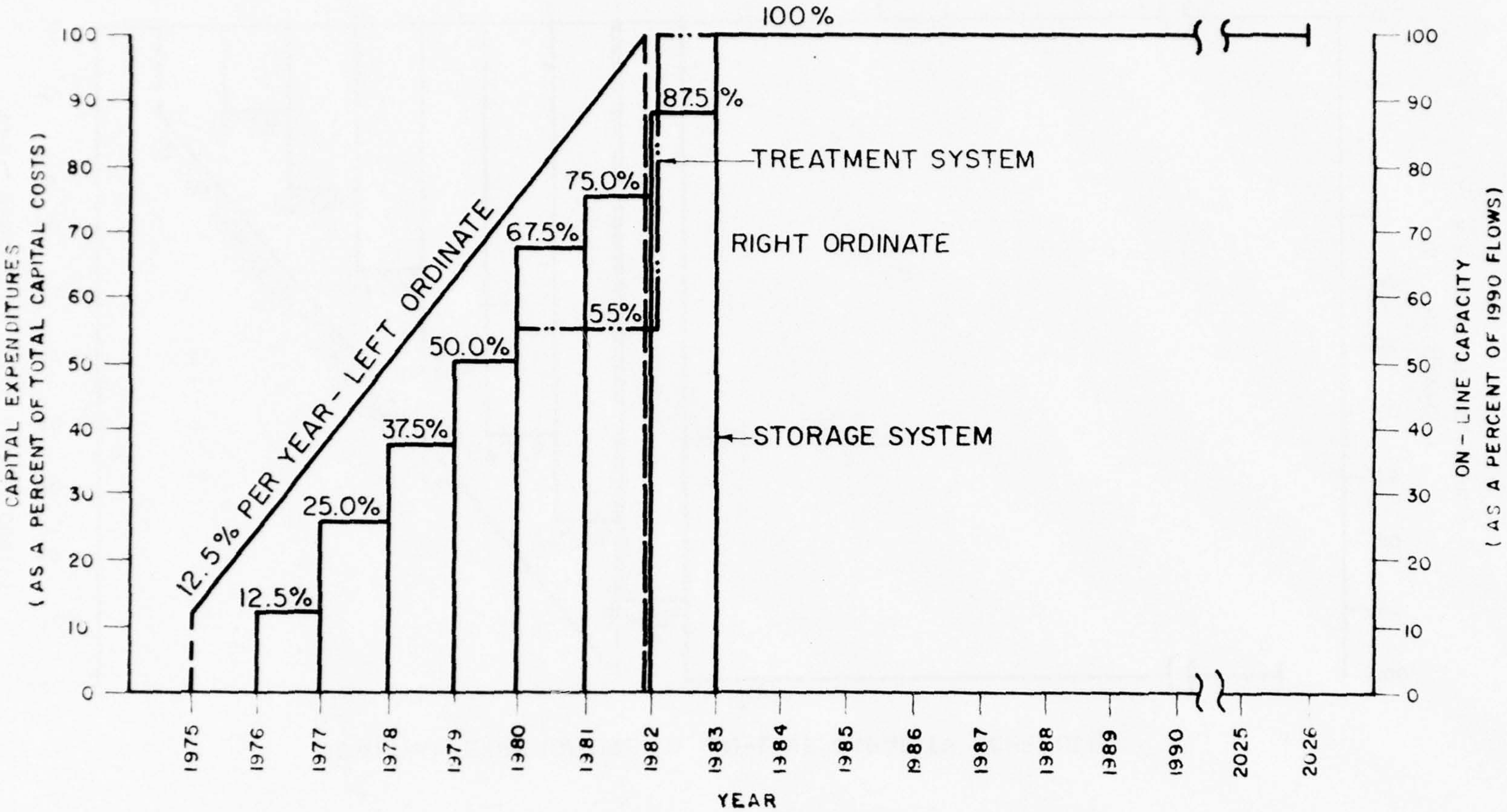


FIGURE D-III-D-5 CONVEYANCE SYSTEMS

CAPITAL EXPENDITURE & ON-LINE CAPACITY SCHEDULE

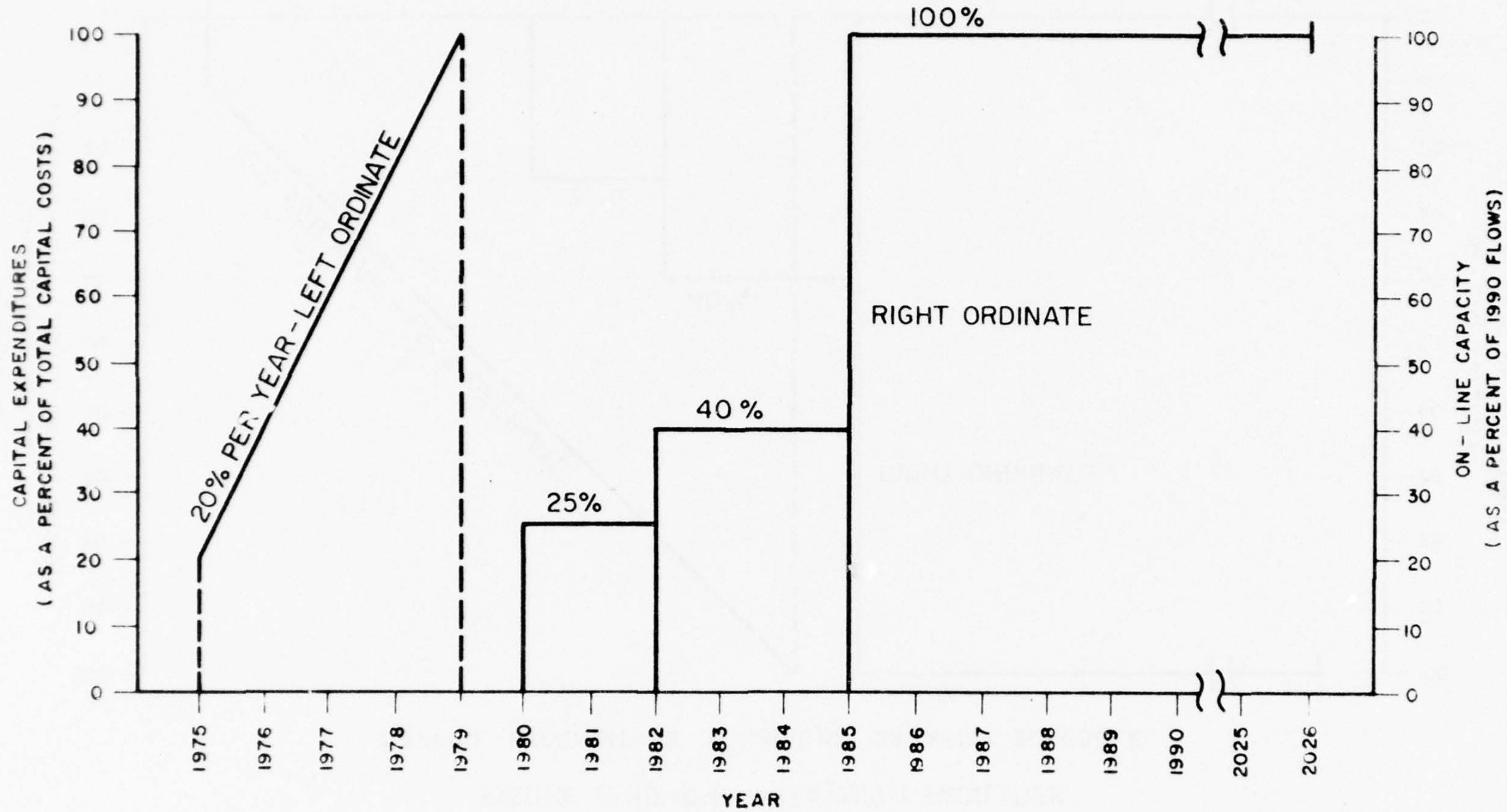
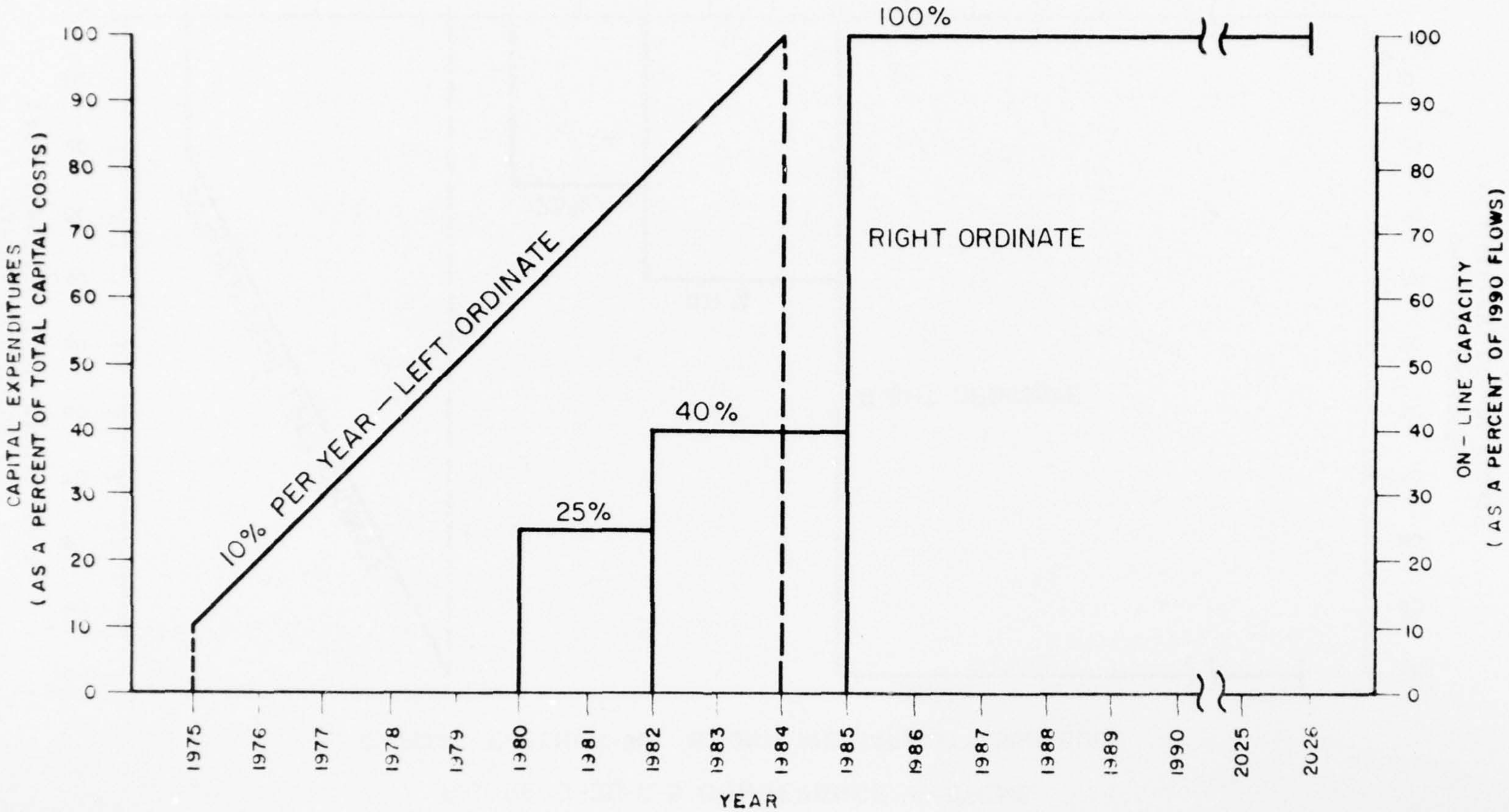


FIGURE D-III-D-6 TREATMENT FACILITIES

CAPITAL EXPENDITURE & ON-LINE CAPACITY SCHEDULE



Sludge Management, Treatment Plants

For the treatment plant alternatives, the construction capital of the sludge management system (both options) is expended at the rate of 10% per year commencing in 1975. Similar to the treatment system, 25% of the sludge management system becomes operational in 1980, 40% in 1982 and 100% by 1985 as shown in Figure D-III-D-7. This system applies to both the with and without separate stormwater analyses.

Sludge Management, Land Treatment

For the land treatment alternatives, the construction capital of the sludge management system (both options) is expended at the rate of 20% per year beginning in 1985. As shown in Figure D-III-D-8, the total system comes on line in 1990. This can be accomplished due to provisions in the storage lagoon for solids accumulation to facilitate dredging operations. The sludge management system applies to both the with and without separate stormwater analyses.

Reuse, Recreational-Navigational

The construction capital expenditure for the recreational-navigational reuse system commences in 1975 at the rate of 12.5% per year. As shown in Figure D-III-D-9, 25% of the system capacity is operational in 1980, 40% in 1982 and 100% by 1985. For the without separate stormwater analysis, the construction capital must be reduced by the cost of the wet-weather reuse transfer stations.

Reuse, Potable

For the potable reuse system, the construction capital expenditure commences in 1982 at the rate of 12.5% per year. As shown in Figure D-III-D-10, the system becomes operational one year after construction at the rate of 12.5% per year. This system applies to the with separate stormwater analysis for both reuse options. The without separate stormwater analysis applies to the 3200 cfs Lake Michigan withdrawal restriction option. For this analysis, the construction capital, replacement and O&M cost must be modified to allow for the substitution of reclaimed M&I flow for potable reuse rather than reclaimed rural stormwater.

FIGURE D-III-D-7 SLUDGE MANAGEMENT SYSTEMS, TREATMENT PLANT ALTS., BOTH OPTIONS

CAPITAL EXPENDITURE & ON-LINE CAPACITY SCHEDULE

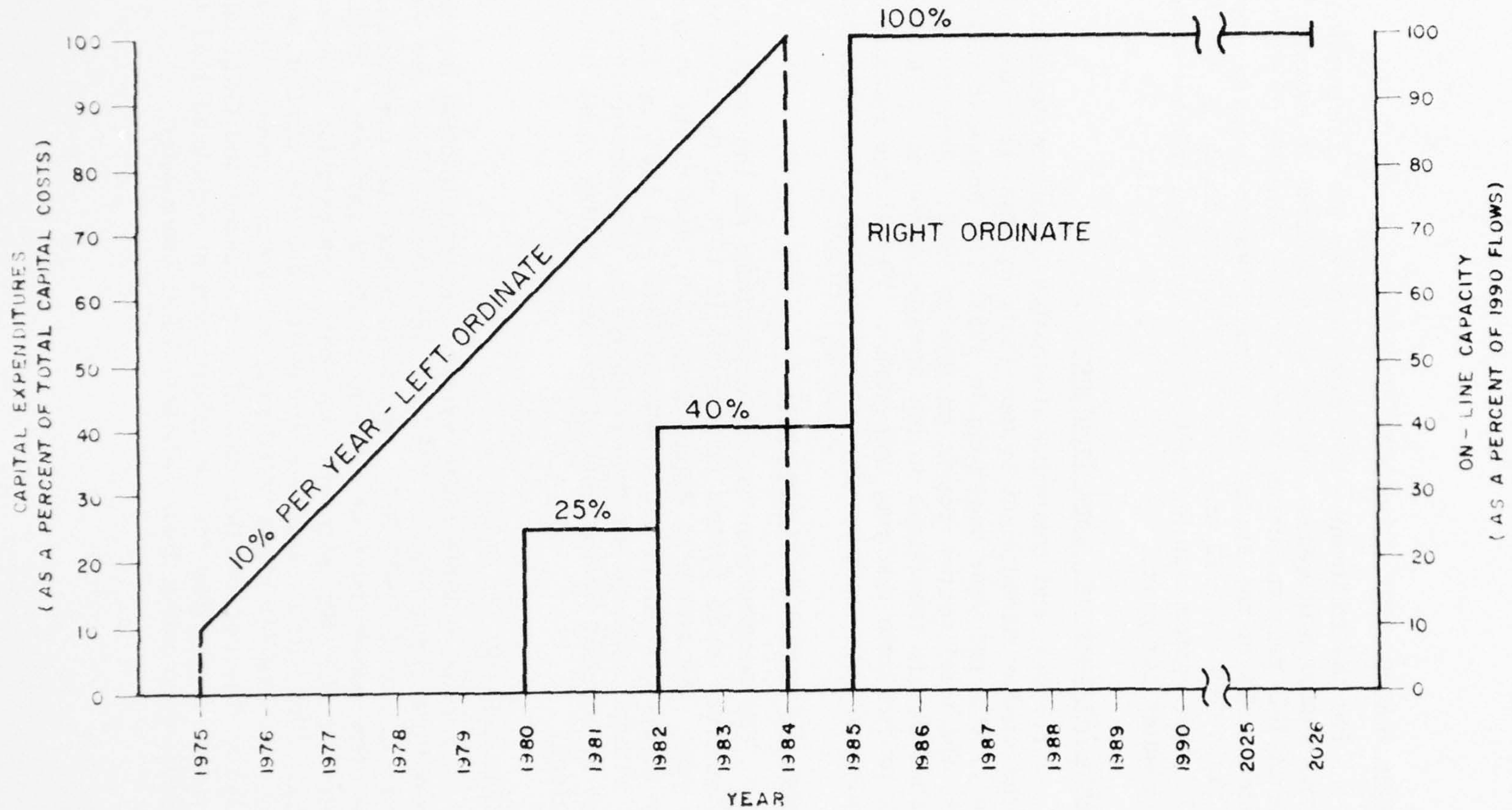


FIGURE D-III-D-8 SLUDGE MANAGEMENT SYSTEMS, TREATMENT PLANT ALTS., BOTH OPTIONS

CAPITAL EXPENDITURE & ON-LINE CAPACITY SCHEDULE

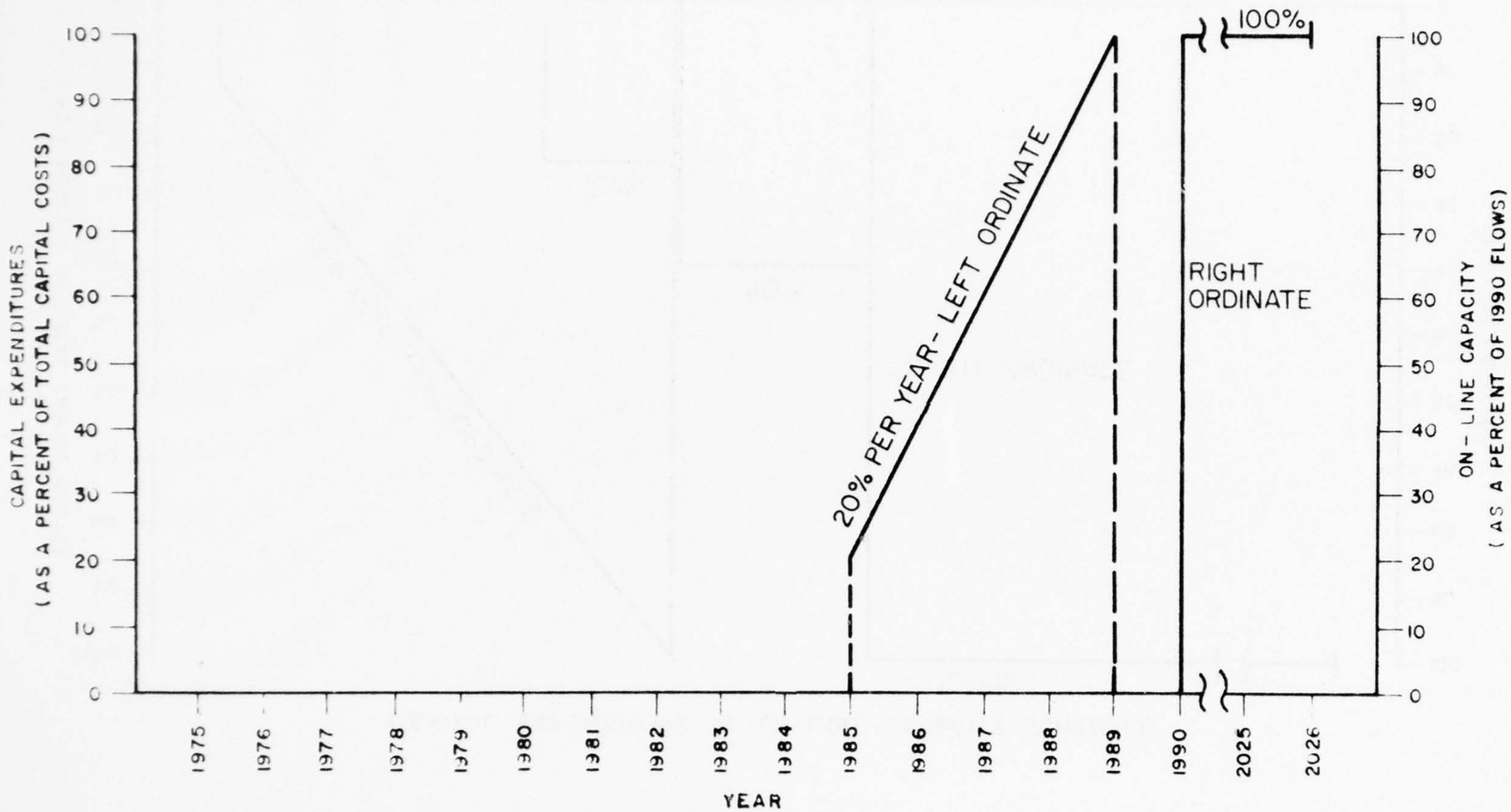


FIGURE D-III-D-9 REUSE SYSTEMS, RECREATIONAL-NAVIGATIONAL

CAPITAL EXPENDITURE & ON-LINE CAPACITY SCHEDULE

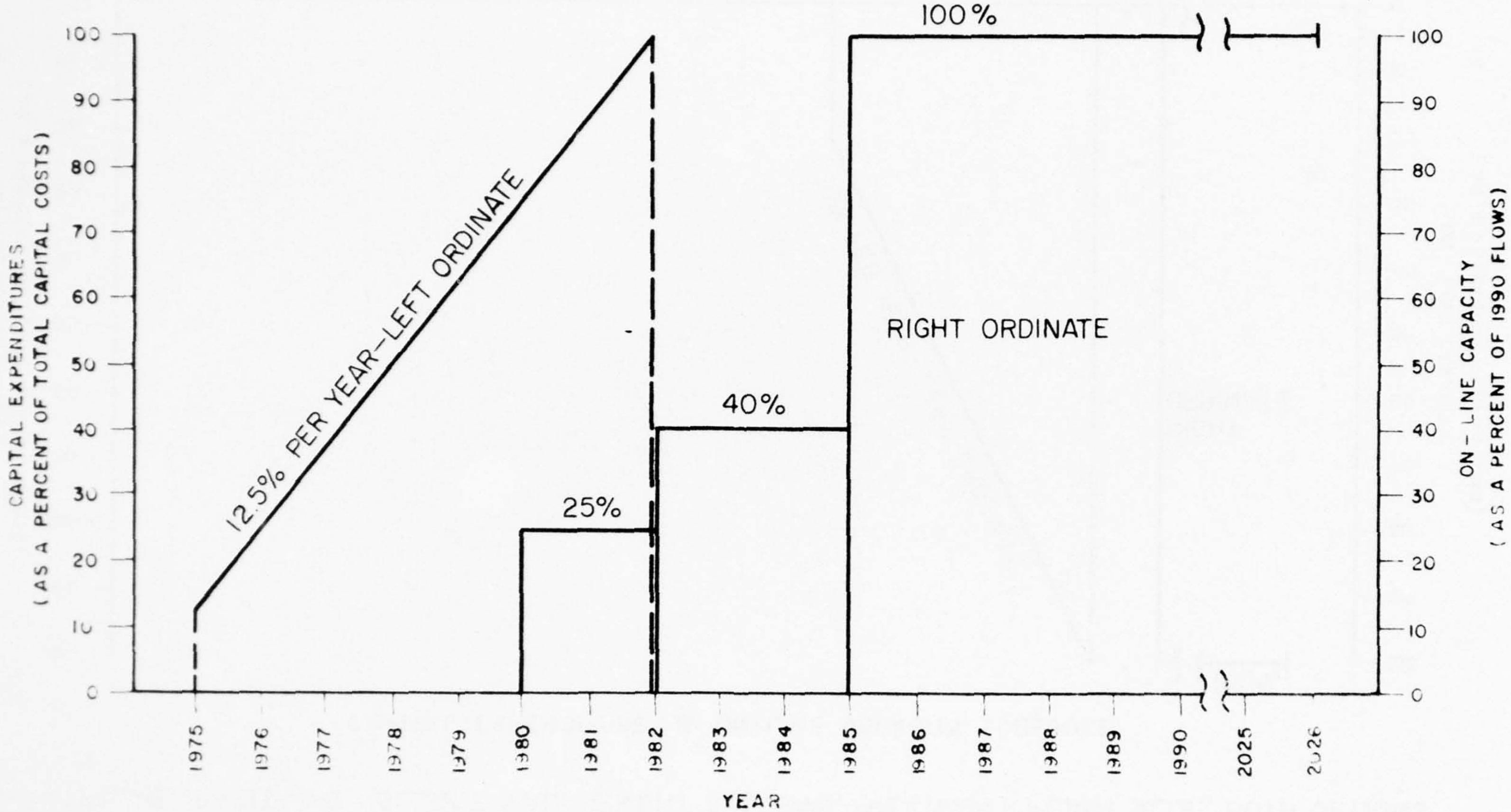
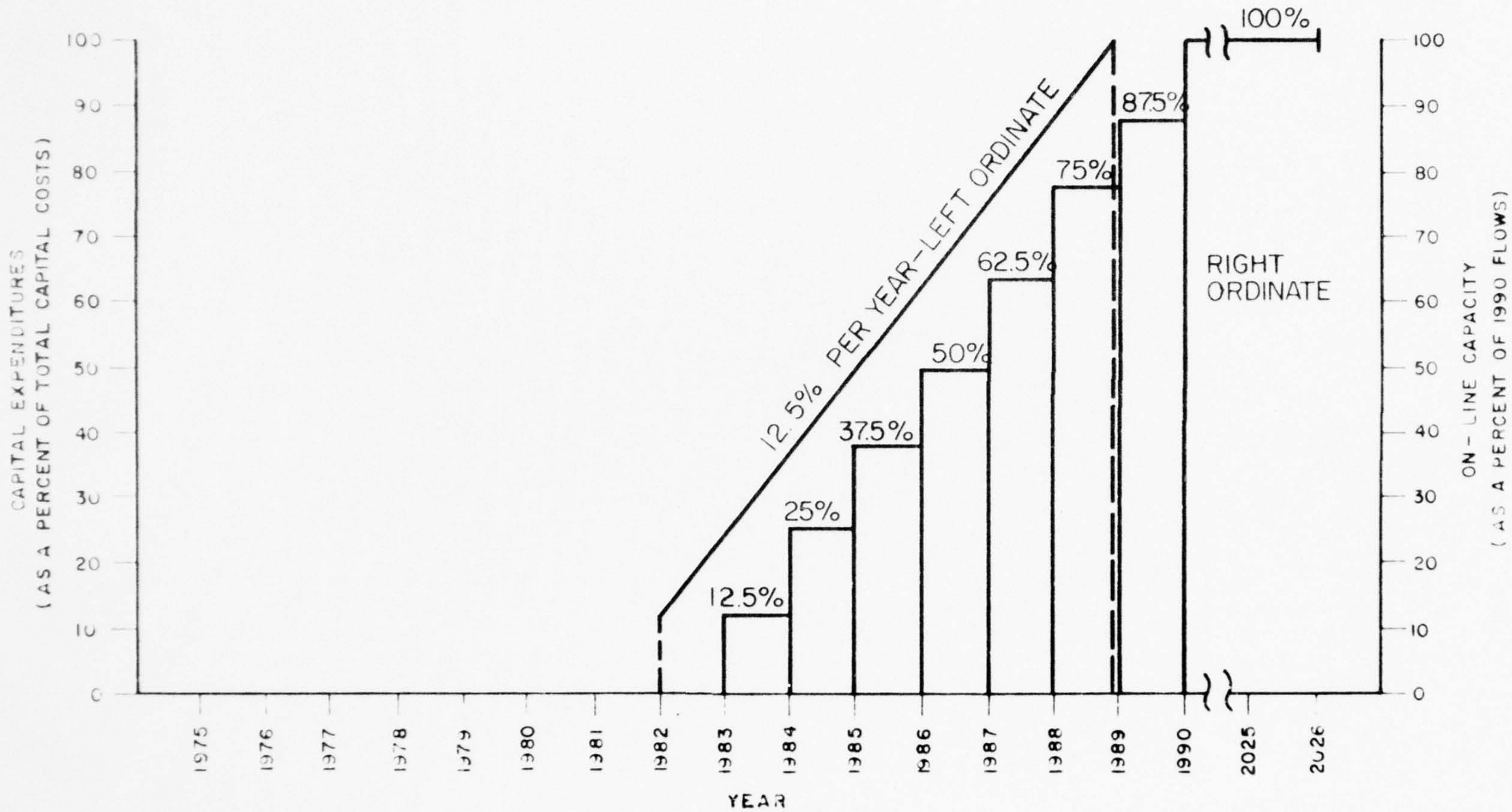


FIGURE D–III–D–10 REUSE SYSTEMS, POTABLE, BOTH OPTIONS

CAPITAL EXPENDITURE & ON-LINE CAPACITY SCHEDULE



E. CONSTRUCTION COST AND START-UP PROGRAM SUMMARY

The implementation and phasing program described by system and systemcomponent in the previous sub-section of this Appendix encompasses a 15 year construction period. Figure D-III-E-1 provides a summary format for the period of consturction capital expenditures for all alternatives, for both the with and without the separate stormwater analyses. Figure D-III-E-2 provides a summary format for expressing the time periods corresponding to percentage capacity of system facilities in operation for with and without separate stormwater. Figure D-III-E-3 provides a representation of the yearly increments of construction capital required for implementation of each alternative with and without separate stormwater, and summed across all alternative systems and system components.

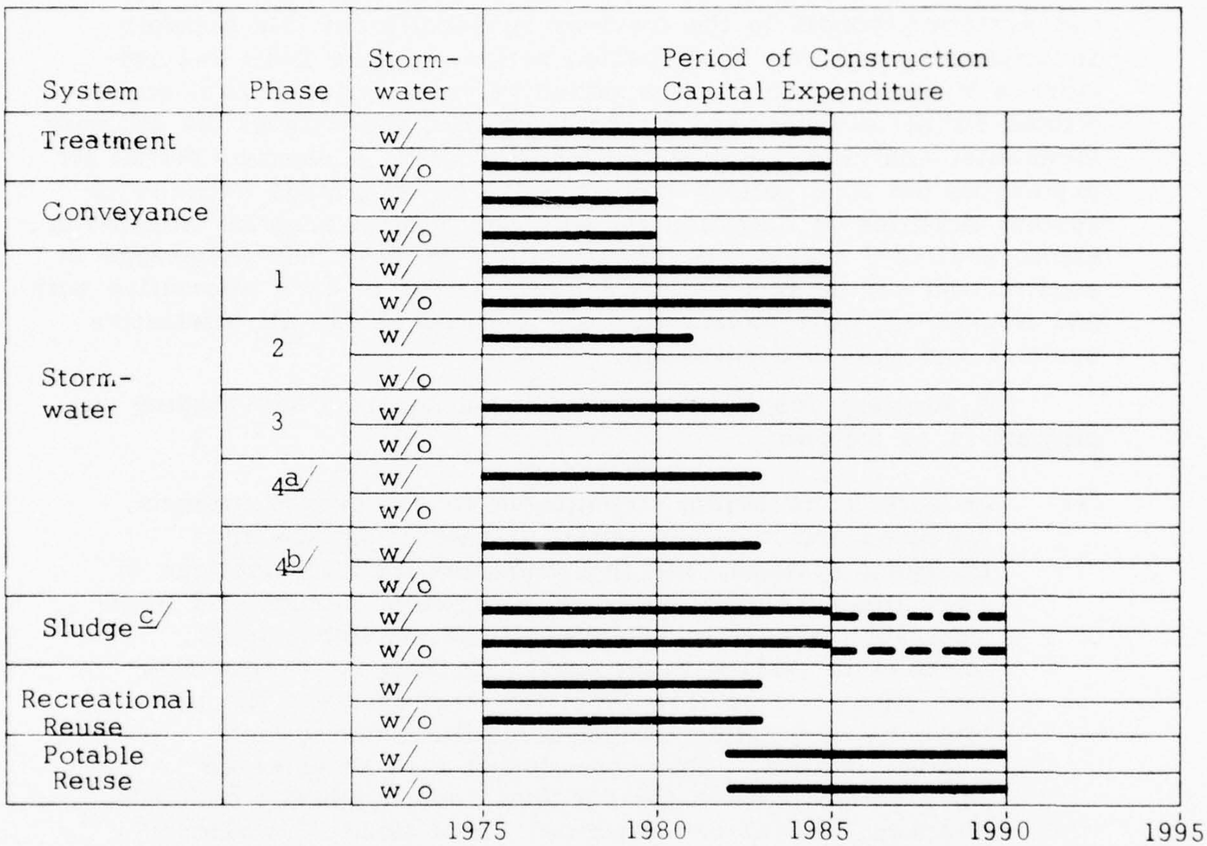
A summary description of this implementation and phasing program is as follows:

(1) An early construction committment to conveyance systems, combined and separate sewer stormwater storage and treatment systems, and implementation of SCS practices in rural areas together with rural stormwater storage and treatment systems. This program will accomplish a rapid increase in surface water quality through stormwater flow regulations. This flow regulation will increase the performance of existing treatment facilities during wet-weather periods. This committment also provides an early action towards the eventual accomplishment of NDCP treatment of M&I and combined sewer flows. It also provides an early action program for flood control together with minimizing soil erosion by interception and storage of stormwater runoff. Inasmuch as conveyance and stormwater collection and storage technologies are least likely to become obsolescent, this committment guarantees minimum capital investment exposed to unnecessary obsolescence.

(2) An early action implementation (1980) of NDCP water quality in watercourses tributary to Lake Michigan from Indiana service areas and in the headwaters of Lake and Du Page Counties, Illinois (1980) and Will County, Illinois (1982) streams.

Figure D-III-E-1

CONSTRUCTION CAPITAL PHASING



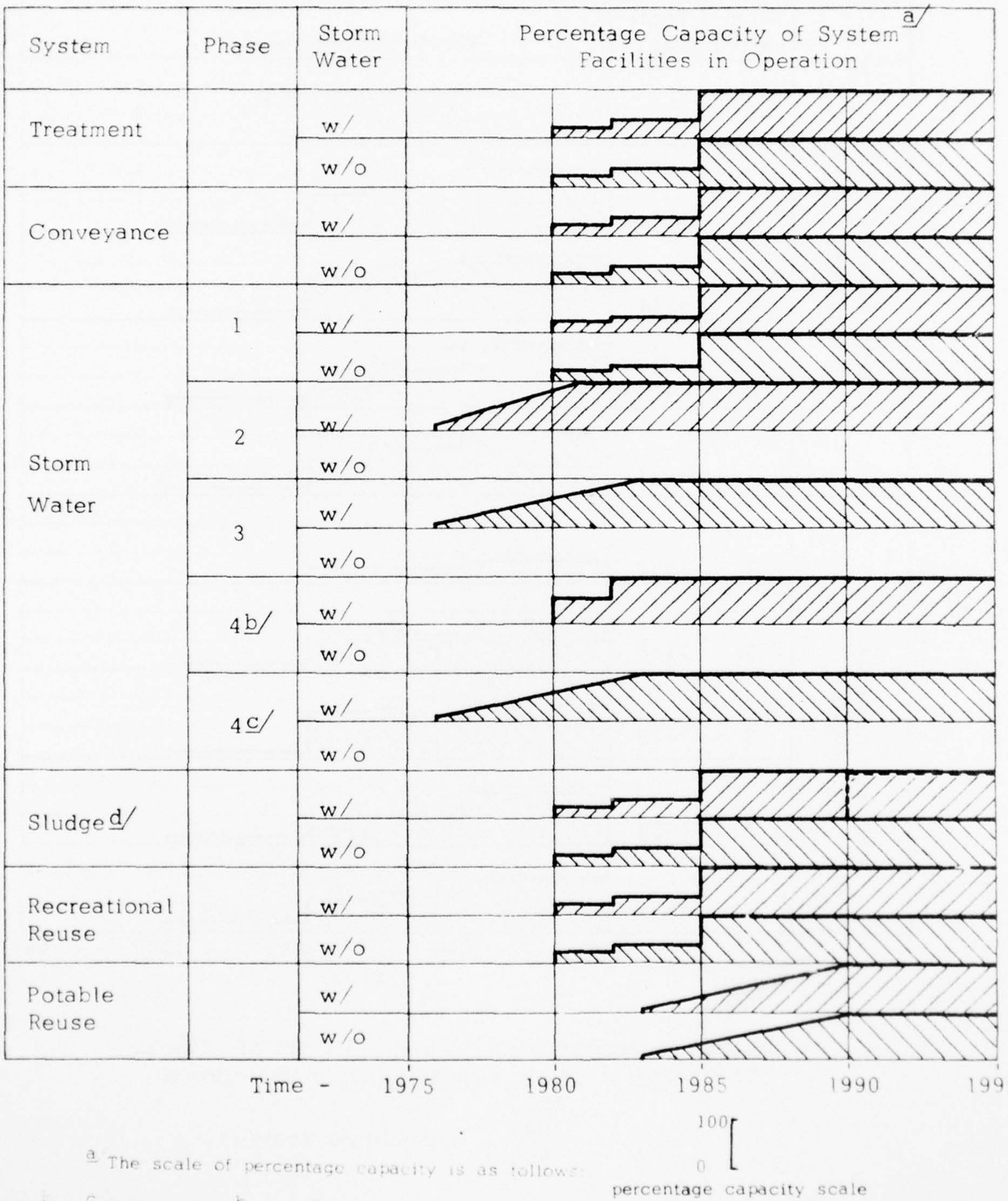
a/ Represents the rural stormwater treatment component of Phase 4.

b/ Represents the rural stormwater storage component of Phase 4.

c/ The solid line represents the sludge management system for alternatives I, II, and III. The sludge management system is represented by the dashed line for Alternative IV. Finally, the sludge management system for Alternative V is represented by the solid plus dashed lines.

Figure D-III-E-2

PERCENTAGE CAPACITY OF SYSTEM FACILITIES IN OPERATION



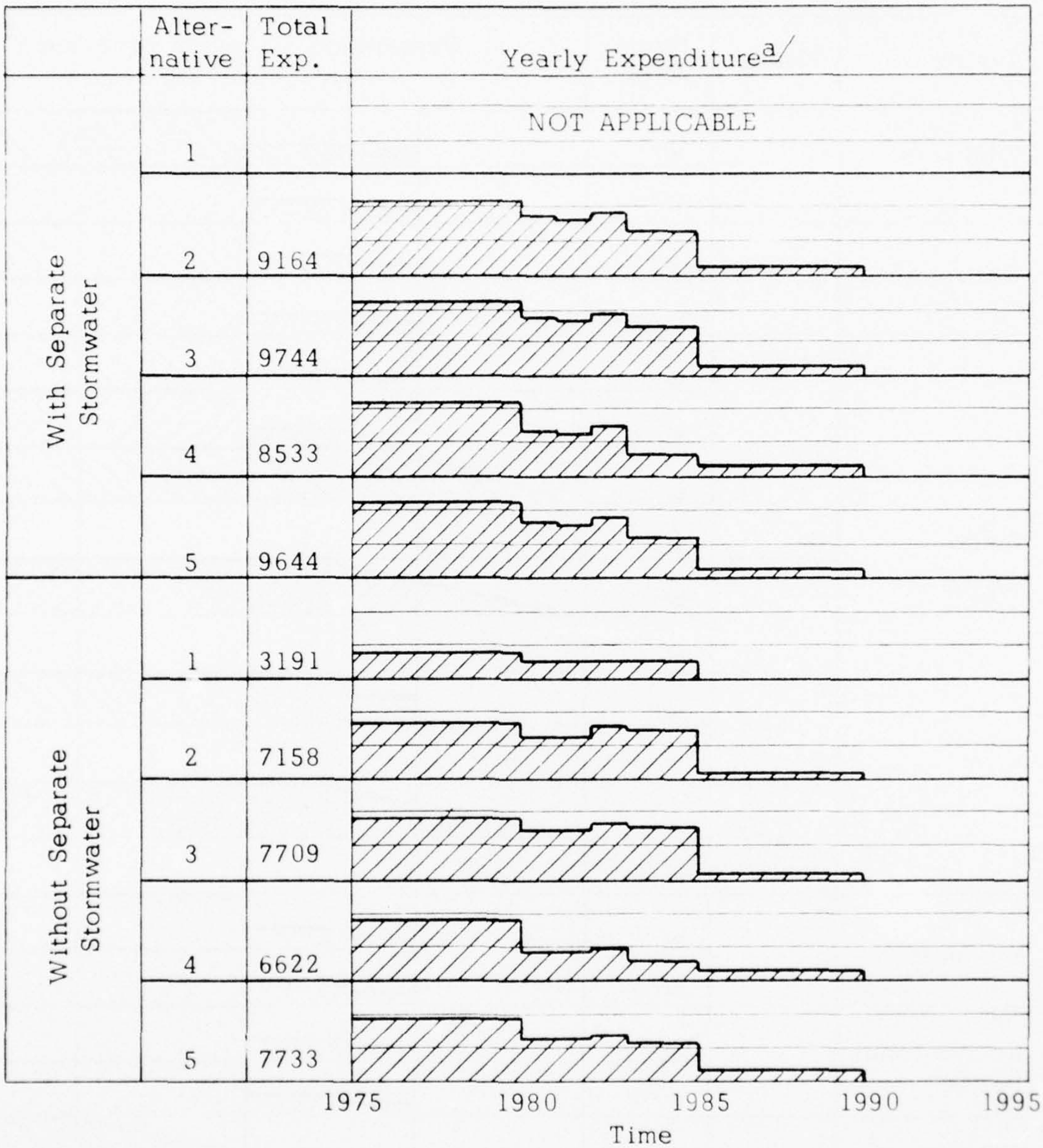
[a] The scale of percentage capacity is as follows:

[b], [c] Superscripts [b] and [c] represent stormwater treatment and stormwater storage systems, respectively.

[d] Sludge management system is represented by the dash line for Alternative 4 and by the solid line plus the dash line for Alternative 5.

Figure D-III-E-3

YEARLY CONSTRUCTION CAPITAL OUTLAY



[a] All expenditures shown are in millions of dollars. The scale of yearly expenditures is as follows:

1500
1000
500
0
Expenditure scale

(3) Large treatment committments held back until mid-construction period (1980 - 1985) to coincide with completion of MSDGC Chicago Underflow Plan scheduled for a 10 year construction period ending in 1985, the ultimate target date for NDCP water quality required by the new 1972 federal water quality legislation.

(4) Recreational-navigational reuse is implemented at a rate compatible with NDCP treatment implementation. Potable reuse is implemented at a rate compatible with C-SELM water needs and consistent with rural stormwater treatment implementation for the within 3200 CFS Lake Michigan withdrawal option.

TECHNICAL APPENDIX D

IV. COST OF REGIONAL WASTEWATER MANAGEMENT ALTERNATIVES

IV COST OF REGIONAL WASTEWATER MANAGEMENT ALTERNATIVES

A. GENERAL

The purpose of this section is to present the costs associated with each of the regional wastewater management alternatives. Sub-section D-IV-B discusses the application of the unit cost data from Appendix B, Basis of Design and Cost, to the phasing and implementation schedules from Appendix D, Section III for the determination of total alternative costs. Sub-section D-IV-C presents detailed cost tables by system component for each of the five alternatives. In addition, this sub-section discusses the general makeup of the costs of each of the system components reported in the cost tables.

Also presented in sub-section D-IV-C are a number of special cost considerations. These include local conveyance systems, loss of tax revenues from purchased lands, salvage value and existing indebtedness of treatment facilities, rock and residual soil management systems, reuse systems and industrial systems.

IV COST OF REGIONAL WASTEWATER MANAGEMENT ALTERNATIVES

B. METHODOLOGY

INTRODUCTION

This section presents the methodology used to determine the cost parameters persented in the following cost tables of Appendix D, Section IV-C. Table D-IV-B-1 presents the format of these cost tables.

The first column of Table D-IV-B-1 identifies the regional management system component. The next two columns present the total capital expenditure associated with each of the system components. This expenditure is broken down into first year expenditure and future years expenditure. The next four columns reflect the present worth costs associated with capital, operation and maintenance (O & M), replacement (Repl.) items, and the sum or total of these three present worth items. The final four columns present the average annual charge associated with the present worth costs.

A discussion of the general methodology associated with determination of each of these values is presented in the following section.

CAPITAL COSTS

Base unit cost data from Appendix B, Section VI were aggregated for each system component design to arrive at a total base cost for each alternative. For example, a base unit cost for a conveyance line would be given in dollars per lineal foot for a specific diameter. This base unit cost would then be multiplied by the number of lineal feet of conveyance of that diameter to arrive at an aggregated base cost figure. This was done for all unit cost items which go into making up a management system component. Again using the conveyance example from above, all conveyance base costs for the many different sizes of conveyance pressure lines, gravity sewers, and driven tunnels are totaled and

TABLE D-IV-B-1 COST TABLE FORMAT

Regional Management System Component	Capital Costs (w/o pr. worth) $ Million		Present Worth Costs $ Million				Average Annual Charge (Pr. worth basis) $ Million			
	First Year	Future Years	Capital	O & M	Repl.	Total	Capital	O & M	Repl.	Total
Treatment System										
Conveyance System										
Stormwater Mgmt. System										
Sludge Mgmt. System										
Reuse System										
Total:										

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then added to the pump station costs to form the total base costs for the conveyance system component of any given alternative.

A similar process was followed for each of the other regional management system components, such as treatment systems, stormwater management systems, sludge management systems and reuse systems, etc.

Once these overall system components base costs were determined, contingency and engineering and administrative costs were added to the base costs. The schedule for these factors is presented in Appendix B, Section V-A.

The final total cost figure for each management system component reflecting base costs, contingency costs and engineering and administrative costs form the basis for the capital cost value which is used in the economic analysis of the system cost. The expenditure of the total capital associated with any given system component follows the capital expenditure schedules discussed in detail in Appendix D, Section III, above, and is reflected in the first two columns of the alternative cost tables.

Table DA-IV-C-9 shows the total quantity of a number of base units for each component of each management system of each Alternative.

Table DA-IV-C-10 shows the number of base units and total costs for the Potable Water Management System Option 1 and 2.

Table DA-IV-C-11 shows the number of base units and total costs for the Sludge Management System Option 1 and 2.

The total costs shown are the average costs for the total number of units. By way of illustration the total cost of conveyance lines includes the costs of a number of individual sizes of lines of particular length. The lengths of all individual lines are then totaled to give the number of feet of conveyance lines used and the costs are added to give the total cost of conveyance. Similar methods were used to obtain the total number of units and total costs for all the component parts of each Management System.

Present Worth of Capital Costs

The present worth of the capital cost was obtained by allocating the total capital costs over its expenditure schedule and then performing a present worth calculation to return each of expenditures to the zero year of the economic analysis. (1975). The conveyance system component can again serve as an example. Figure D-III-D-5 shows the capital expenditure schedule for the conveyance system component. This schedule shows that 20 percent of the capital cost is expended each year for five years. The expenditure is assumed to take place on the first of each year. No interest is charged during construction.

Average Annual Charge for Capital Costs

The average annual charge for capital costs is obtained by amortizing the present worth of the capital costs over the economic life of the system. Therefore, the average annual charge figure will have a component for interest on the present worth of the capital cost and another component for the sinking fund to recover the capital.

OPERATION AND MAINTENANCE COSTS

Operation and Maintenance costs (O & M) are determined on a unit base cost method and were presented in Appendix B, Basis of Design and Costs. The O & M costs are given on an annual figure when aggregated from the unit cost base. For example, the conveyance system O & M costs consist of two base unit cost items: 1) manpower requirements and miscellaneous maintenance parts and 2) power consumption. Item 1 was obtained as a simple percentage of the base capital cost plus contingencies, for a yearly figure. Item 2 was determined from actual power requirements of the pump stations installed in the conveyance system, and aggregated to a total kilowatt hours requirement for an entire year of pumpage, based on the 1990 level of flows. This annual power requirement was then multiplied by the assumed cost of power to determine the annual power cost.

A similar analysis was performed for O & M costs for other regional management system components such as treatment systems, stormwater management systems, etc.

Present Worth of Operation and Maintenance Costs

O & M costs are an annual cost based on the 1990 level of flow. However, during the implementation period there are O & M costs are reduced because the flow treated is less than the 1990 level. The O & M costs associated within this time frame are assumed to be a percentage of the 1990 cost. For example, the conveyance system O & M costs during its implementation period are assumed to be a function of the on-line capacity of the system. The percentage of on-line capacity is given in Appendix D, Section III-D. For the conveyance example, Figure D-III-D-5 shows the percentage of on-line capacity as a function of the 1990 flow. This shows that in 1980, 25 percent of the total capacity is on-line, in 1982, 15 percent more capacity is on-line and in 1985 capacity is assumed to be 100 percent of 1990 levels.

To obtain the present worth of the annual O & M expenditures, the costs in each year are determined and this O & M expenditure is returned to the zero year, 1975. This analysis is applied over the entire 50 year life of the system.

Average Annual Charge for Operation and Maintenance Costs

The average annual charge for the O & M costs is calculated on a present worth basis by simply multiplying the present worth of the O & M cost by the capital recovery factor.

REPLACEMENT COSTS

Replacement costs are determined on a unit cost basis and aggregated over all cost items for each system component. The unit replacement costs are based upon individual replacement schedules for the many capital expenditure items in each system component. This schedules and their associated replacement items are presented in Appendix B, Section VI.

The conveyance system is again a good example. In this component, the pump stations are the only replaceable item, within the economic life of the system. The replacement schedule for this component calls for a replacement of certain items on a 10 year and 25 year basis. These two unit replacement costs, 10 and 25 year, are aggregated over the entire conveyance system. This was assumed to be a lump sum payment made at the first of the year of replacement.

Present Worth for Replacement Costs

Replacement costs were returned to the zero year of 1975 by a simple present worth calculation from the year of the replacement expenditure. For example, in the conveyance system ten year replacement period only, there would be a series of ten year replacement expenditures through the economic life of the system. In addition, there are three distinctly different start-up periods for the replacement schedule associated with the on-line capacity schedule as discussed in the O & M cost section above.

Average Annual Charge for Replacement Costs

The average annual charge for the replacement costs was obtained by amortizing the present worth of replacement cost over the 50 year economic life of the analysis.

C. ALTERNATIVE COSTS

INDIVIDUAL ALTERNATIVE COST TABLES

The following tables present the cost associated with each of the five regional wastewater management alternatives. The format and production of these tables was discussed above.

The tables reflect the four interest rates of five, five and one-half, seven, and ten percent. In addition, where applicable the tables reflect the two different sludge management options, agricultural utilization and land reclamation.

The tables have two rows of numbers for each regional wastewater management system component and each column. The top number is the cost associated with the management alternative including all stormwater flows; the bottom number reflects the cost associated with the management alternative but including only combined sewer stormwater flows. The combined sewer stormwater management system includes the Chicago Underflow Plan serving a 375 square mile service area and a dispersed number of mined and surface combined storages serving an additional total combined service area of 210 square miles.

Tables D-IV-C-1 through D-IV-C-4 present costs associated with Alternative I, the Reference Plan, at the four interest rates, and for only agricultural utilization sludge management. Tables D-IV-C-5 through D-IV-C-8 present the costs associated with Alternative II, the Physical-Chemical Treatment Plan, at the four interest rates with agricultural utilization sludge management. Tables D-IV-C-9 through D-IV-C-16 present the costs associated with the Advanced Biological Treatment Plan for the four interest rates and both sludge management options. Tables D-IV-C-17 through D-IV-C-24 present the costs associated with the Land Treatment Plan for the four interest rates and both sludge management options. Tables D-IV-C-25 through D-IV-C-32 present the costs associated with the Advanced Biological-Land Treatment Combination Plan, at the four interest rates for both sludge management options.

Table D-IV-C-1. ALTERNATIVE COSTS

ALTERNATIVE I
REFERENCE PLAN
SLUDGE OPTION: AGRICULTURAL UTILIZATION
INTEREST RATE: 5.0%

Regional Management System Component	Capital Costs (w/o pr. worth) $ Million		Present Worth Costs $ Million				Average Annual Charge (Pr. worth basis) $ Million			
	First Year	Future Years	Capital	O & M	Repl.	Total	Capital	O & M	Repl.	Total
Treatment System	0 131	0 1179	0 1062	0 287	0 234	0 1583	0 57	0 16	0 13	0 86
Conveyance System	0 169	0 677	0 770	0 81	0 8	0 859	0 42	0 4	0 0	0 47
Stormwater Mgmt. System	0 83	0 751	0 677	0 50	0 17	0 743	0 37	0 3	0 1	0 41
Sludge Mgmt. System	0 26	0 236	0 213	0 101	0 60	0 373	0 12	0 6	0 3	0 20
Reuse System	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
Total:	0 410	0 2844	0 2721	0 518	0 319	0 3558	0 148	0 28	0 17	0 194

Note: Upper figures designate costs with stormwater, lower figures designate costs without stormwater except in combined sewer areas.

Table D-IV-C-2. ALTERNATIVE COSTS

ALTERNATIVE I
REFERENCE PLAN
SLUDGE OPTION: AGRICULTURAL UTILIZATION
INTEREST RATE: 5.5%

Regional Management System Component	Capital Costs (w/o pr. worth) $ Million		Present Worth Costs $ Million				Average Annual Charge (Pr. worth basis) $ Million			
	First Year	Future Years	Capital	O & M	Repl.	Total	Capital	O & M	Repl.	Total
Treatment System	0 131	0 1179	0 1041	0 259	0 204	0 1505	0 61	0 15	0 12	0 88
Conveyance System	0 169	0 677	0 763	0 73	0 7	0 843	0 45	0 4	0 0	0 50
Stormwater Mgmt. System	0 83	0 751	0 664	0 45	0 15	0 724	0 39	0 3	0 1	0 43
Sludge Mgmt. System	0 26	0 236	0 209	0 91	0 52	0 351	0 12	0 5	0 3	0 21
Reuse System	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
Total:	0 410	0 2844	0 2677	0 468	0 278	0 3422	0 157	0 28	0 16	0 201

Note: Upper figures designate costs with stormwater, lower figures designate costs without stormwater except in combined sewer areas.

Table D-IV-C-3. ALTERNATIVE COSTS

ALTERNATIVE I
REFERENCE PLAN
SLUDGE OPTION: AGRICULTURAL UTILIZATION
INTEREST RATE: 7.0%

Regional Management System Component	Capital Costs (w/o pr. worth) $ Million		Present Worth Costs $ Million				Average Annual Charge (Pr. worth basis) $ Million			
	First Year	Future Years	Capital	O & M	Repl.	Total	Capital	O & M	Repl.	Total
Treatment System	0 131	0 1179	0 984	0 194	0 137	0 1315	0 71	0 14	0 10	0 95
Conveyance System	0 169	0 677	0 743	0 55	0 5	0 803	0 54	0 4	0 0	0 58
Stormwater Mgmt. System	0 83	0 751	0 627	0 34	0 10	0 671	0 45	0 2	0 1	0 49
Sludge Mgmt. System	0 26	0 236	0 197	0 68	0 34	0 300	0 14	0 5	0 2	0 22
Reuse System	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
Total:	0 410	0 2844	0 2551	0 351	0 187	0 3089	0 184	0 25	0 14	0 223

Note: Upper figures designate costs with stormwater, lower figures designate costs without stormwater except in combined sewer areas.

Table D-IV-C-4. ALTERNATIVE COSTS

ALTERNATIVE I
REFERENCE PLAN
SLUDGE OPTION: AGRICULTURAL UTILIZATION
INTEREST RATE: 10.0%

Regional Management System Component	Capital Costs (w/o pr. worth) $ Million		Present Worth Costs $ Million				Average Annual Charge (Pr. worth basis) $ Million			
	First Year	Future Years	Capital	O & M	Repl.	Total	Capital	O & M	Repl.	Total
Treatment System	0 131	0 1179	0 885	0 117	0 65	0 1067	0 89	0 12	0 7	0 107
Conveyance System	0 169	0 677	0 706	0 33	0 3	0 742	0 71	0 3	0 0	0 75
Stormwater Mgmt. System	0 83	0 751	0 564	0 20	0 5	0 590	0 57	0 2	0 1	0 59
Sludge Mgmt. System	0 26	0 236	0 177	0 41	0 16	0 234	0 18	0 4	0 2	0 24
Reuse System	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
Total:	0 410	0 2844	0 2332	0 211	0 89	0 2633	0 235	0 21	0 9	0 265

Note: Upper figures designate costs with stormwater, lower figures designate costs without stormwater except in combined sewer areas.

Table D-IV-C-5. ALTERNATIVE COSTS

ALTERNATIVE II
PHYSICAL-CHEMICAL TREATMENT PLAN
SLUDGE OPTION: AGRICULTURAL UTILIZATION
INTEREST RATE: 5.0%

Regional Management System Component	Capital Costs (w/o pr. worth) $ Million		Present Worth Costs $ Million				Average Annual Charge (Pr. worth basis) $ Million			
	First Year	Future Years	Capital	O & M	Repl.	Total	Capital	O & M	Repl.	Total
Treatment System	408 398	3668 3584	3305 3229	3624 3214	685 635	7614 7078	181 177	199 176	38 35	417 388
Conveyance System	199 184	796 736	905 836	89 85	15 11	1009 931	50 46	5 5	1 1	55 51
Stormwater Mgmt. System	298 83	2236 751	2120 677	725 50	82 17	2927 743	116 37	40 3	4 1	160 41
Sludge Mgmt. System	123 123	1108 1108	998 998	298 298	106 106	1402 1402	55 55	16 16	6 6	77 77
Reuse System	8 7	53 49	52 48	44 39	3 3	99 90	3 3	2 2	0 0	5 5
Total:	1035 796	7863 6228	7380 5787	4780 3685	891 771	13051 10244	404 317	262 202	49 42	715 561

Note: Upper figures designate costs with stormwater, lower figures designate costs without stormwater except in combined sewer areas.

Table D-IV-C-6. ALTERNATIVE COSTS

ALTERNATIVE II
PHYSICAL-CHEMICAL TREATMENT PLAN
SLUDGE OPTION: AGRICULTURAL UTILIZATION
INTEREST RATE: 5.5%

Regional Management System Component	Capital Costs (w/o pr. worth) $ Million		Present Worth Costs $ Million				Average Annual Charge (Pr. worth basis) $ Million			
	First Year	Future Years	Capital	O & M	Repl.	Total	Capital	O & M	Repl.	Total
Treatment System	408 398	3668 3584	3241 3167	3272 2901	608 564	7122 6632	191 187	193 171	36 33	421 392
Conveyance System	199 184	796 736	897 828	81 76	13 9	991 914	53 49	5 5	1 1	59 54
Stormwater Mgmt. System	298 83	2236 751	2085 664	662 45	72 15	2820 724	123 39	39 3	4 1	167 43
Sludge Mgmt. System	123 123	1108 1108	979 979	269 269	92 92	1340 1340	58 58	16 16	5 5	79 79
Reuse System	8 7	53 49	51 47	40 35	3 2	94 85	3 3	2 2	0 0	6 5
Total:	1035 796	7863 6228	7254 5685	4324 3327	788 683	12366 9694	428 336	255 197	47 40	730 573

Note: Upper figures designate costs with stormwater, lower figures designate costs without stormwater except in combined sewer areas.

Table D-IV-C-7. ALTERNATIVE COSTS

ALTERNATIVE II
PHYSICAL-CHEMICAL TREATMENT PLAN
SLUDGE OPTION: AGRICULTURAL UTILIZATION
INTEREST RATE: 7.0%

Regional Management System Component	Capital Costs (w/o pr. worth) $ Million		Present Worth Costs $ Million				Average Annual Charge (Pr. worth basis) $ Million			
	First Year	Future Years	Capital	O & M	Repl.	Total	Capital	O & M	Repl.	Total
Treatment System	408 398	3668 3584	3063 2993	2453 2175	432 401	5948 5568	222 217	178 158	31 29	431 403
Conveyance System	199 184	796 736	873 807	61 57	9 7	943 870	63 58	4 4	1 0	68 63
Stormwater Mgmt. System	298 83	2236 751	1987 627	514 34	51 10	2552 671	144 45	37 2	4 1	185 49
Sludge Mgmt. System	123 123	1108 1108	925 925	202 202	61 61	1188 1188	67 67	15 15	4 4	86 86
Reuse System	8 7	53 49	49 45	30 27	2 2	81 73	4 3	2 2	0 0	6 5
Total:	1035 796	7863 6228	6897 5397	3260 2494	555 480	10711 8371	500 391	236 181	40 35	776 607

Note: Upper figures designate costs with stormwater, lower figures designate costs without stormwater except in combined sewer areas.

Table D-IV-C-8. ALTERNATIVE COSTS

ALTERNATIVE II
PHYSICAL-CHEMICAL TREATMENT PLAN
SLUDGE OPTION: AGRICULTURAL UTILIZATION
INTEREST RATE: 10.0%

Regional Management System Component	Capital Costs (w/o pr. worth) $ Million		Present Worth Costs $ Million				Average Annual Charge (Pr. worth basis) $ Million			
	First Year	Future Years	Capital	O & M	Repl.	Total	Capital	O & M	Repl.	Total
Treatment System	408 398	3663 3584	2755 2691	1480 1312	232 215	4467 4218	278 271	149 132	23 22	450 425
Conveyance System	199 184	796 736	830 767	37 35	5 3	871 805	84 77	4 3	0 0	88 81
Stormwater Mgmt. System	298 83	2236 751	1814 564	335 20	26 5	2175 590	183 57	34 2	3 1	219 59
Sludge Mgmt. System	123 123	1108 1108	832 832	122 122	28 28	982 982	84 84	12 12	3 3	99 99
Reuse System	8 7	53 49	45 41	18 16	1 1	64 58	5 4	2 2	0 0	6 6
Total:	1035 796	7863 6228	6276 4896	1991 1505	291 252	8558 6653	633 494	201 152	29 25	863 671

Note: Upper figures designate costs with stormwater, lower figures designate costs without stormwater except in combined sewer areas.

Table D-IV-C-9. ALTERNATIVE COSTS

ALTERNATIVE III
ADVANCED BIOLOGICAL TREATMENT PLAN
SLUDGE OPTION: AGRICULTURAL UTILIZATION
INTEREST RATE: 5.0%

Regional Management System Component	Capital Costs (w/o pr. worth) $ Million		Present Worth Costs $ Million				Average Annual Charge (Pr. worth basis) $ Million			
	First Year	Future Years	Capital	O & M	Repl.	Total	Capital	O & M	Repl.	Total
Treatment System	561 549	5050 4939	4549 4449	3533 3133	898 841	8980 8423	249 244	194 172	49 46	492 461
Conveyance System	211 196	844 783	959 890	92 88	16 12	1067 991	53 49	5 5	1 1	58 54
Stormwater Mgmt. System	298 83	2236 751	2120 677	725 50	82 17	2927 743	116 37	40 3	4 1	160 41
Sludge Mgmt. System	22 22	197 197	178 178	65 65	37 37	279 279	10 10	4 4	2 2	15 15
Reuse System	7 7	52 48	50 46	42 38	3 3	95 87	3 3	2 2	0 0	5 5
Total:	1099 857	8379 6718	7856 6240	4457 3374	1036 910	13349 10523	430 342	244 185	57 50	731 576

Note: Upper figures designate costs with stormwater, lower figures designate costs without stormwater except in combined sewer areas.

Table D-IV-C-10. ALTERNATIVE COSTS

ALTERNATIVE III
ADVANCED BIOLOGICAL TREATMENT PLAN
SLUDGE OPTION: AGRICULTURAL UTILIZATION
INTEREST RATE: 5.5%

Regional Management System Component	Capital Costs (w/o pr. worth) $ Million		Present Worth Costs $ Million				Average Annual Charge (Pr. worth basis) $ Million			
	First Year	Future Years	Capital	O & M	Repl.	Total	Capital	O & M	Repl.	Total
Treatment System	561 549	5050 4939	4462 4364	3190 2828	791 742	8443 7934	264 258	188 167	47 44	499 469
Conveyance System	211 196	844 783	950 882	83 80	15 11	1048 973	56 52	5 5	1 1	62 57
Stormwater Mgmt. System	298 83	2236 751	2085 664	662 45	72 15	2820 724	123 39	39 3	4 1	167 43
Sludge Mgmt. System	22 22	197 197	174 174	59 59	32 32	265 265	10 10	3 3	2 2	16 16
Reuse System	7 7	52 48	50 46	38 34	3 2	90 82	3 3	2 2	0 0	5 5
Total:	1099 857	8379 6718	7721 6129	4032 3046	913 802	12666 9977	456 362	238 180	54 47	748 589

Note: Upper figures designate costs with stormwater, lower figures designate costs without stormwater except in combined sewer areas.

Table D-IV-C-11. ALTERNATIVE COSTS

ALTERNATIVE III
ADVANCED BIOLOGICAL TREATMENT PLAN
SLUDGE OPTION: AGRICULTURAL UTILIZATION
INTEREST RATE: 7.0%

Regional Management System Component	Capital Costs (w/o pr. worth) $ Million		Present Worth Costs $ Million				Average Annual Charge (Pr. worth basis) $ Million			
	First Year	Future Years	Capital	O & M	Repl.	Total	Capital	O & M	Repl.	Total
Treatment System	561 549	5050 4939	4217 4124	2392 2120	550 515	7158 6760	306 299	173 154	40 37	519 490
Conveyance System	211 196	844 783	926 859	62 60	10 8	998 926	67 62	5 4	1 1	72 67
Stormwater Mgmt. System	298 83	2236 751	1987 627	514 34	51 10	2552 671	144 45	37 2	4 1	185 49
Sludge Mgmt. System	22 22	197 197	165 165	44 44	21 21	230 230	12 12	3 3	2 2	17 17
Reuse System	7 7	52 48	48 44	28 26	2 2	78 71	3 3	2 2	0 0	6 5
Total:	1099 857	8379 6718	7341 5818	3040 2283	634 556	11015 8658	532 422	220 165	46 40	798 627

Note: Upper figures designate costs with stormwater, lower figures designate costs without stormwater except in combined sewer areas.

Table D-IV-C-12. ALTERNATIVE COSTS

ALTERNATIVE III
ADVANCED BIOLOGICAL TREATMENT PLAN
SLUDGE OPTION: AGRICULTURAL UTILIZATION
INTEREST RATE: 10.0%

Regional Management System Component	Capital Costs (w/o pr. worth) $ Million		Present Worth Costs $ Million				Average Annual Charge (Pr. worth basis) $ Million			
	First Year	Future Years	Capital	O & M	Repl.	Total	Capital	O & M	Repl.	Total
Treatment System	561 549	5050 4939	3792 3709	1443 1279	282 264	5517 5253	382 374	146 129	28 27	556 530
Conveyance System	211 196	844 783	880 816	38 36	5 4	922 856	89 82	4 4	1 0	93 86
Stormwater Mgmt. System	298 83	2236 751	1814 564	335 20	26 5	2175 590	183 57	34 2	3 1	219 59
Sludge Mgmt. System	22 22	197 197	148 148	27 27	10 10	184 184	15 15	3 3	1 1	19 19
Reuse System	7 7	52 48	44 40	17 16	1 1	62 56	4 4	2 2	0 0	6 6
Total:	1099 857	8379 6718	6677 5277	1859 1378	324 284	8860 6939	.673 532	187 139	33 29	894 700

Note: Upper figures designate costs with stormwater, lower figures designate costs without stormwater except in combined sewer areas.

Table D-IV-C-13. ALTERNATIVE COSTS

ALTERNATIVE III
ADVANCED BIOLOGICAL TREATMENT PLAN
SLUDGE OPTION: LAND RECLAMATION
INTEREST RATE: 5.0%

Regional Management System Component	Capital Costs (w/o pr. worth) $ Million		Present Worth Costs $ Million				Average Annual Charge (Pr. worth basis) $ Million			
	First Year	Future Years	Capital	O & M	Repl.	Total	Capital	O & M	Repl.	Total
Treatment System	561 549	5050 4939	4549 4449	3533 3133	898 841	8980 8423	249 244	194 172	49 46	492 461
Conveyance System	211 196	844 783	959 890	92 88	16 12	1067 991	53 49	5 5	1 1	58 54
Stormwater Mgmt. System	298 83	2236 751	2120 677	725 50	82 17	2927 743	116 37	40 3	4 1	160 41
Sludge Mgmt. System	34 34	309 309	278 278	101 101	148 148	527 527	15 15	6 6	8 8	29 29
Reuse System	7 7	52 48	50 46	42 38	3 3	95 87	3 3	2 2	0 0	5 5
Total:	1112 869	8490 6829	7957 6340	4492 3409	1147 1022	13596 10771	436 347	246 187	63 56	745 590

Note: Upper figures designate costs with stormwater, lower figures designate costs without stormwater except in combined sewer areas.

Table D-IV-C-14. ALTERNATIVE COSTS

ALTERNATIVE III
ADVANCED BIOLOGICAL TREATMENT PLAN
SLUDGE OPTION: LAND RECLAMATION
INTEREST RATE: 5.5%

Regional Management System Component	Capital Costs (w/o pr. worth) $ Million		Present Worth Costs $ Million				Average Annual Charge (Pr. worth basis) $ Million			
	First Year	Future Years	Capital	O & M	Repl.	Total	Capital	O & M	Repl.	Total
Treatment System	561 549	5050 4939	4462 4364	3190 2828	791 742	8443 7934	264 258	188 167	47 44	499 469
Conveyance System	211 196	844 783	950 882	83 80	15 11	1048 973	56 52	5 5	1 1	62 57
Stormwater Mgmt. System	298 83	2236 751	2085 664	662 45	72 15	2820 724	123 39	39 3	4 1	167 43
Sludge Mgmt. System	34 34	309 309	273 273	91 91	130 130	494 494	16 16	5 5	8 8	29 29
Reuse System	7 7	52 48	50 46	38 34	3 2	90 82	3 3	2 2	0 0	5 5
Total:	1112 869	8490 6829	7820 6228	4064 3078	1011 900	12895 10206	462 368	240 182	60 53	762 603

Note: Upper figures designate costs with stormwater, lower figures designate costs without stormwater except in combined sewer areas.

Table D-IV-C-15. ALTERNATIVE COSTS

ALTERNATIVE III
ADVANCED BIOLOGICAL TREATMENT PLAN
SLUDGE OPTION: LAND RECLAMATION
INTEREST RATE: 7.0%

Regional Management System Component	Capital Costs (w/o pr. worth) $ Million		Present Worth Costs $ Million				Average Annual Charge (Pr. worth basis) $ Million			
	First Year	Future Years	Capital	O & M	Repl.	Total	Capital	O & M	Repl.	Total
Treatment System	561 549	5050 4939	4217 4124	2392 2120	550 515	7158 6760	306 299	173 154	40 37	519 490
Conveyance System	211 196	844 783	926 859	62 60	10 8	998 926	67 62	5 4	1 1	72 67
Stormwater Mgmt. System	298 83	2236 751	1987 627	514 34	51 10	2552 671	144 45	37 2	4 1	185 49
Sludge Mgmt. System	34 34	309 309	258 258	68 68	90 90	415 415	19 19	5 5	7 7	30 30
Reuse System	7 7	52 48	48 44	28 26	2 2	73 71	3 3	2 2	0 0	6 5
Total:	1112 869	8490 6829	7434 5911	3065 2308	702 625	11201 8844	539 428	222 167	51 45	812 641

Note: Upper figures designate costs with stormwater, lower figures designate costs without stormwater except in combined sewer areas.

Table D-IV-C-16. ALTERNATIVE COSTS

ALTERNATIVE III
ADVANCED BIOLOGICAL TREATMENT PLAN
SLUDGE OPTION: LAND RECLAMATION
INTEREST RATE: 10.0%

Regional Management System Component	Capital Costs (w/o pr. worth) $ Million		Present Worth Costs $ Million				Average Annual Charge (Pr. worth basis) $ Million			
	First Year	Future Years	Capital	O & M	Repl.	Total	Capital	O & M	Repl.	Total
Treatment System	561 549	5050 4939	3792 3709	1443 1279	282 264	5517 5253	382 374	146 129	28 27	556 530
Conveyance System	211 196	844 783	880 816	38 36	5 4	922 856	89 82	4 4	1 0	93 86
Stormwater Mgmt. System	298 83	2236 751	1814 564	335 20	26 5	2175 590	183 57	34 2	3 1	219 59
Sludge Mgmt. System	34 34	309 309	232 232	41 41	45 45	318 318	23 23	4 4	5 5	32 32
Reuse System	7 7	52 48	44 40	17 16	1 1	62 56	4 4	2 2	0 0	6 6
Total:	1112 869	8490 6829	6761 5361	1873 1392	359 319	8994 7073	682 541	189 140	36 32	907 713

Note: **Upper figures designate costs with stormwater, lower figures designate costs without stormwater** except in combined sewer areas.

Table D-IV-C-17. ALTERNATIVE COSTS

ALTERNATIVE IV
LAND TREATMENT PLAN
SLUDGE OPTION: AGRICULTURAL UTILIZATION
INTEREST RATE: 5.0%

Regional Management System Component	Capital Costs (w/o pr. worth) $ Million		Present Worth Costs $ Million				Average Annual Charge (Pr. worth basis) $ Million			
	First Year	Future Years	Capital	O & M	Repl.	Total	Capital	O & M	Repl.	Total
Treatment System	251 251	2257 2257	2033 2033	1636 1487	213 213	3882 3733	111 111	90 81	12 12	213 204
Conveyance System	388 373	1554 1493	1766 1697	140 136	17 13	1923 1846	97 93	8 7	1 1	105 101
Stormwater Mgmt. System	304 90	2278 793	2160 718	729 54	87 23	2977 795	118 39	40 3	5 1	163 43
Sludge Mgmt. System	0 0	106 106	59 59	46 46	4 4	110 110	3 3	3 3	0 0	6 6
Reuse System	138 138	969 965	939 935	286 284	16 16	1241 1235	51 51	16 16	1 1	68 68
Total:	1082 852	7164 5614	6958 5442	2837 2007	338 269	10134 7719	381 298	155 110	19 15	555 423

Note: Upper figures designate costs with stormwater, lower figures designate costs without stormwater except in combined sewer areas.

Table D-IV-C-18. ALTERNATIVE COSTS

ALTERNATIVE IV
LAND TREATMENT PLAN
SLUDGE OPTION: AGRICULTURAL UTILIZATION
INTEREST RATE: 5.5%

Regional Management System Component	Capital Costs (w/o pr. worth) $ Million		Present Worth Costs $ Million				Average Annual Charge (Pr. worth basis) $ Million			
	First Year	Future Years	Capital	O & M	Repl.	Total	Capital	O & M	Repl.	Total
Treatment System	251 251	2257 2257	1994 1994	1477 1342	188 188	3659 3524	118 118	87 79	11 11	216 208
Conveyance System	388 373	1554 1493	1750 1682	126 123	15 12	1892 1816	103 99	7 7	1 1	112 107
Stormwater Mgmt. System	304 90	2278 793	2126 704	666 49	77 20	2869 773	125 41	39 3	5 1	169 46
Sludge Mgmt. System	0 0	106 106	56 56	41 41	4 4	101 101	3 3	2 2	0 0	6 6
Reuse System	138 138	969 965	925 921	273 271	15 14	1213 1207	55 54	16 16	1 1	72 71
Total:	1082 852	7164 5614	6851 5357	2584 1827	299 238	9734 7422	405 318	153 108	18 14	575 438

Note: Upper figures designate costs with stormwater, lower figures designate costs without stormwater except in combined sewer areas.

Table D-IV-C-19. ALTERNATIVE COSTS

ALTERNATIVE IV
LAND TREATMENT PLAN
SLUDGE OPTION: AGRICULTURAL UTILIZATION
INTEREST RATE: 7.0%

Regional Management System Component	Capital Costs (w/o pr. worth) $ Million		Present Worth Costs $ Million				Average Annual Charge (Pr. worth basis) $ Million			
	First Year	Future Years	Capital	O & M	Repl.	Total	Capital	O & M	Repl.	Total
Treatment System	251 251	2257 2257	1885 1885	1107 1006	130 130	3122 3021	137 137	80 73	9 9	226 219
Conveyance System	388 373	1554 1493	1704 1638	95 92	11 8	1810 1738	124 119	7 7	1 1	131 126
Stormwater Mgmt. System	304 90	2278 793	2025 666	518 37	55 14	2597 717	146 48	38 3	4 1	187 52
Sludge Mgmt. System	0 0	106 106	47 47	30 30	3 3	80 80	3 3	2 2	0 0	6 6
Reuse System	138 138	969 965	884 881	238 237	12 11	1134 1129	64 64	17 17	1 1	82 82
Total:	1082 852	7164 5614	6545 5116	1989 1403	210 167	8744 6686	473 371	144 102	15 12	633 484

Note: Upper figures designate costs with stormwater, lower figures designate costs without stormwater except in combined sewer areas.

Table D-IV-C-20. ALTERNATIVE COSTS

ALTERNATIVE IV
LAND TREATMENT PLAN
SLUDGE OPTION: AGRICULTURAL UTILIZATION
INTEREST RATE: 10.0%

Regional Management System Component	Capital Costs (w/o pr. worth) $ Million		Present Worth Costs $ Million				Average Annual Charge (Pr. worth basis) $ Million			
	First Year	Future Years	Capital	O & M	Repl.	Total	Capital	O & M	Repl.	Total
Treatment System	251 251	2257 2257	1695 1695	668 607	66 66	2429 2368	171 171	67 61	7 7	245 239
Conveyance System	388 373	1554 1493	1620 1557	57 56	5 4	1682 1616	163 157	6 6	1 0	170 163
Stormwater Mgmt. System	304 90	2278 793	1848 600	337 22	29 8	2213 630	186 60	34 2	3 1	223 63
Sludge Mgmt. System	0 0	106 106	34 34	17 17	1 1	53 53	3 3	2 2	0 0	5 5
Reuse System	138 138	969 965	812 809	183 182	7 7	1003 998	82 82	18 18	1 1	101 101
Total:	1082 852	7164 5614	6009 4694	1263 885	109 86	7381 5665	606 473	127 89	11 9	744 571

Note: Upper figures designate costs with stormwater, lower figures designate costs without stormwater except in combined sewer areas.

Table D-IV-C-21. ALTERNATIVE COSTS

ALTERNATIVE IV
LAND TREATMENT PLAN
SLUDGE OPTION: LAND RECLAMATION
INTEREST RATE: 5.0%

Regional Management System Component	Capital Costs (w/o pr. worth) $ Million		Present Worth Costs $ Million				Average Annual Charge (Pr. worth basis) $ Million			
	First Year	Future Years	Capital	O & M	Repl.	Total	Capital	O & M	Repl.	Total
Treatment System	251 251	2257 2257	2033 2033	1636 1487	213 213	3882 3733	111 111	90 81	12 12	213 204
Conveyance System	388 373	1554 1493	1766 1697	140 136	17 13	1923 1846	97 93	8 7	1 1	105 101
Stormwater Mgmt. System	304 90	2278 793	2160 718	729 54	87 23	2977 795	118 39	40 3	5 1	163 43
Sludge Mgmt. System	0 0	206 206	115 115	56 56	38 38	209 209	6 6	3 3	2 2	11 11
Reuse System	138 138	969 965	939 935	286 284	16 16	1241 1235	51 51	16 16	1 1	68 68
Total:	1082 852	7264 5714	7014 5498	2847 2017	372 303	10233 7818	384 301	156 110	20 17	560 428

Note: Upper figures designate costs with stormwater, lower figures designate costs without stormwater except in combined sewer areas.

Table D-IV-C-22. ALTERNATIVE COSTS

ALTERNATIVE IV
LAND TREATMENT PLAN
SLUDGE OPTION: LAND RECLAMATION
INTEREST RATE: 5.5%

Regional Management System Component	Capital Costs (w/o pr. worth) $ Million		Present Worth Costs $ Million				Average Annual Charge (Pr. worth basis) $ Million			
	First Year	Future Years	Capital	O & M	Repl.	Total	Capital	O & M	Repl.	Total
Treatment System	251 251	2257 2257	1994 1994	1477 1342	188 188	3659 3524	118 118	87 79	11 11	216 203
Conveyance System	388 373	1554 1493	1750 1682	126 123	15 12	1892 1816	103 99	7 7	1 1	112 107
Stormwater Mgmt. System	304 90	2278 793	2126 704	666 49	77 20	2869 773	125 41	39 3	5 1	169 46
Sludge Mgmt. System	0 0	206 206	109 109	50 50	33 33	192 192	6 6	3 3	2 2	11 11
Reuse System	138 138	969 965	925 921	273 271	15 14	1213 1207	55 54	16 16	1 1	72 71
Total:	1082 852	7264 5714	6904 5409	2593 1836	329 267	9825 7513	408 319	153 108	19 16	580 444

Note: Upper figures designate costs with stormwater, lower figures designate costs without stormwater except in combined sewer areas.

Table D-IV-C-23. ALTERNATIVE COSTS

ALTERNATIVE IV
LAND TREATMENT PLAN
SLUDGE OPTION: LAND RECLAMATION
INTEREST RATE: 7.0%

Regional Management System Component	Capital Costs (w/o pr. worth) $ Million		Present Worth Costs $ Million				Average Annual Charge (Pr. worth basis) $ Million			
	First Year	Future Years	Capital	O & M	Repl.	Total	Capital	O & M	Repl.	Total
Treatment System	251 251	2257 2257	1885 1885	1107 1006	130 130	3122 3021	137 137	80 73	9 9	226 219
Conveyance System	388 373	1554 1493	1704 1638	95 92	11 8	1810 1738	124 119	7 7	1 1	131 126
Stormwater Mgmt. System	304 90	2278 793	2025 666	518 37	55 14	2597 717	146 48	38 3	4 1	187 52
Sludge Mgmt. System	0 0	206 206	92 92	37 37	22 22	151 151	7 7	3 3	2 2	11 11
Reuse System	138 138	969 965	884 881	238 237	12 11	1134 1129	64 64	17 17	1 1	82 82
Total:	1082 852	7264 5714	6590 5161	1995 1409	229 186	8814 6756	477 374	145 102	17 14	638 490

Note: Upper figures designate costs with stormwater, lower figures designate costs without stormwater except in combined sewer areas.

Table D-IV-C-24. ALTERNATIVE COSTS

ALTERNATIVE IV
LAND TREATMENT PLAN
SLUDGE OPTION: LAND RECLAMATION
INTEREST RATE: 10.0%

Regional Management System Component	Capital Costs (w/o pr. worth) $ Million		Present Worth Costs $ Million				Average Annual Charge (Pr. worth basis) $ Million			
	First Year	Future Years	Capital	O & M	Repl.	Total	Capital	O & M	Repl.	Total
Treatment System	251 251	2257 2257	1695 1695	668 607	66 66	2429 2368	171 171	67 61	7 7	245 239
Conveyance System	388 373	1554 1493	1620 1557	57 56	5 4	1682 1616	163 157	6 6	1 0	170 163
Stormwater Mgmt. System	304 90	2278 793	1848 600	337 22	29 8	2213 630	186 60	34 2	3 1	223 63
Sludge Mgmt. System	0 0	206 206	66 66	21 21	10 10	97 97	7 7	2 2	1 1	10 10
Reuse System	138 138	969 965	812 809	183 182	7 7	1003 998	82 82	18 18	1 1	101 101
Total:	1082 852	7264 5714	6042 4726	1266 888	118 95	7426 5710	609 476	128 90	12 10	748 575

Note: Upper figures designate costs with stormwater, lower figures designate costs without stormwater except in combined sewer areas.

Table D-IV-C-25. ALTERNATIVE COSTS

ALTERNATIVE V
ADVANCED BIOLOGICAL-LAND TREATMENT COMBINATION PLAN
SLUDGE OPTION: AGRICULTURAL UTILIZATION
INTEREST RATE: 5.0%

Regional Management System Component	Capital Costs (w/o pr. worth) $ Million		Present Worth Costs $ Million				Average Annual Charge (Pr. worth basis) $ Million			
	First Year	Future Years	Capital	O & M	Repl.	Total	Capital	O & M	Repl.	Total
Treatment System	438 438	3938 3938	3548 3548	3020 2834	694 694	7262 7075	194 194	165 155	38 38	398 388
Conveyance System	310 295	1241 1180	1410 1341	119 115	18 14	1547 1470	77 73	7 6	1 1	85 81
Stormwater Mgmt. System	304 90	2278 793	2160 718	729 54	87 23	2977 795	118 39	40 3	5 1	163 43
Sludge Mgmt. System	19 19	169 169	152 152	78 78	30 30	260 260	8 8	4 4	2 2	14 14
Reuse System	83 82	578 574	560 556	201 197	14 13	775 767	31 30	11 11	1 1	42 42
Total:	1153 923	8204 6654	7831 6315	4148 3279	842 773	12821 10367	429 346	227 180	46 42	702 568

Note: Upper figures designate costs with stormwater, lower figures designate costs without stormwater except in combined sewer areas.

Table D-IV-C-26. ALTERNATIVE COSTS

ALTERNATIVE V
ADVANCED BIOLOGICAL-LAND TREATMENT COMBINATION PLAN
SLUDGE OPTION: AGRICULTURAL UTILIZATION
INTEREST RATE: 5.5%

Regional Management System Component	Capital Costs (w/o pr. worth) $ Million		Present Worth Costs $ Million				Average Annual Charge (Pr. worth basis) $ Million			
	First Year	Future Years	Capital	O & M	Repl.	Total	Capital	O & M	Repl.	Total
Treatment System	438 438	3938 3938	3480 3480	2727 2558	611 611	6818 6650	206 206	161 151	36 36	403 393
Conveyance System	310 295	1241 1180	1398 1329	107 104	16 12	1521 1445	83 78	6 6	1 1	90 85
Stormwater Mgmt. System	304 90	2278 793	2126 704	666 49	77 20	2869 773	125 41	39 3	5 1	169 46
Sludge Mgmt. System	19 19	169 169	149 149	71 71	26 26	246 246	9 9	4 4	2 2	15 15
Reuse System	83 82	578 574	552 548	181 178	12 11	745 737	33 32	11 11	1 1	44 44
Total:	1153 923	8204 6654	7704 6210	3752 2961	742 681	12199 9851	455 367	222 175	44 40	720 582

Note: Upper figures designate costs with stormwater, lower figures designate costs without stormwater except in combined sewer areas.

Table D-IV-C-27. ALTERNATIVE COSTS

ALTERNATIVE V
ADVANCED BIOLOGICAL-LAND TREATMENT COMBINATION PLAN
SLUDGE OPTION: AGRICULTURAL UTILIZATION
INTEREST RATE: 7.0%

Regional Management System Component	Capital Costs (w/o pr. worth) $ Million		Present Worth Costs $ Million				Average Annual Charge (Pr. worth basis) $ Million			
	First Year	Future Years	Capital	O & M	Repl.	Total	Capital	O & M	Repl.	Total
Treatment System	438 438	3938 3938	3289 3289	2044 1918	425 425	5758 5632	238 238	148 139	31 31	417 408
Conveyance System	310 295	1241 1180	1361 1294	80 78	11 8	1452 1381	99 94	6 6	1 1	105 100
Stormwater Mgmt. System	304 90	2278 793	2025 666	518 37	55 14	2597 717	146 48	38 3	4 1	137 52
Sludge Mgmt. System	19 19	169 169	141 141	53 53	17 17	211 211	10 10	4 4	1 1	15 15
Reuse System	83 82	578 574	527 524	136 134	8 8	672 665	38 38	10 10	1 1	49 48
Total:	1153 923	8204 6654	7343 5914	2831 2220	516 472	10690 8606	531 429	205 161	37 34	774 624

Note: Upper figures designate costs with stormwater, lower figures designate costs without stormwater except in combined sewer areas.

Table D-IV-C-28. ALTERNATIVE COSTS

ALTERNATIVE V
ADVANCED BIOLOGICAL-LAND TREATMENT COMBINATION PLAN
SLUDGE OPTION: AGRICULTURAL UTILIZATION
INTEREST RATE: 10.0%

Regional Management System Component	Capital Costs (w/o pr. worth) $ Million		Present Worth Costs $ Million				Average Annual Charge (Pr. worth basis) $ Million			
	First Year	Future Years	Capital	O & M	Repl.	Total	Capital	O & M	Repl.	Total
Treatment System	438 438	3938 3938	2958 2958	1233 1157	218 218	4409 4333	298 298	124 117	22 22	445 437
Conveyance System	310 295	1241 1180	1294 1230	49 47	5 4	1348 1281	130 124	5 5	1 0	136 129
Stormwater Mgmt. System	304 90	2278 793	1848 600	337 22	29 8	2213 630	186 60	34 2	3 1	223 63
Sludge Mgmt. System	19 19	169 169	127 127	32 32	8 8	167 167	13 13	3 3	1 1	17 17
Reuse System	83 82	578 574	484 481	82 81	4 4	571 565	49 49	8 8	0 0	58 57
Total:	1153 923	8204 6654	6711 5395	1733 1339	264 241	8707 6976	676 543	175 135	27 24	878 703

Note: Upper figures designate costs with stormwater, lower figures designate costs without stormwater except in combined sewer areas.

Table D-IV-C-29. ALTERNATIVE COSTS

ALTERNATIVE V
ADVANCED BIOLOGICAL-LAND TREATMENT COMBINATION PLAN
SLUDGE OPTION: LAND RECLAMATION
INTEREST RATE: 5.0%

Regional Management System Component	Capital Costs (w/o pr. worth) $ Million		Present Worth Costs $ Million				Average Annual Charge (Pr. worth basis) $ Million			
	First Year	Future Years	Capital	O & M	Repl.	Total	Capital	O & M	Repl.	Total
Treatment System	438 438	3938 3938	3548 3548	3020 2834	694 694	7262 7075	194 194	165 155	38 38	398 388
Conveyance System	310 295	1241 1180	1410 1341	119 115	18 14	1547 1470	77 73	7 6	1 1	85 81
Stormwater Mgmt. System	304 90	2278 793	2160 718	729 54	87 23	2977 795	118 39	40 3	5 1	163 43
Sludge Mgmt. System	29 29	265 265	239 239	107 107	134 134	479 479	13 13	6 6	7 7	26 26
Reuse System	83 82	578 574	560 556	201 197	14 13	775 767	31 30	11 11	1 1	42 42
Total:	1164 934	8301 6750	7918 6402	4176 3307	946 876	13040 10586	434 351	229 181	52 48	714 580

Note: Upper figures designate costs with stormwater, lower figures designate costs without stormwater except in combined sewer areas.

Table D-IV-C-30. ALTERNATIVE COSTS

ALTERNATIVE V
ADVANCED BIOLOGICAL-LAND TREATMENT COMBINATION PLAN
SLUDGE OPTION: LAND RECLAMATION
INTEREST RATE: 5.5%

Regional Management System Component	Capital Costs (w/o pr. worth) $ Million		Present Worth Costs $ Million				Average Annual Charge (Pr. worth basis) $ Million			
	First Year	Future Years	Capital	O & M	Repl.	Total	Capital	O & M	Repl.	Total
Treatment System	438 438	3938 3938	3480 3480	2727 2558	611 611	6818 6650	206 206	161 151	36 36	403 393
Conveyance System	310 295	1241 1180	1398 1329	107 104	16 12	1521 1445	83 78	6 6	1 1	90 85
Stormwater Mgmt. System	304 90	2278 793	2126 704	666 49	77 20	2869 773	125 41	39 3	5 1	169 46
Sludge Mgmt. System	29 29	265 265	234 234	96 96	118 118	448 448	14 14	6 6	7 7	26 26
Reuse System	83 82	578 574	552 548	181 178	12 11	745 737	33 32	11 11	1 1	44 44
Total:	1164 934	8301 6750	7789 6295	3778 2986	834 772	12401 10053	460 372	223 176	49 46	732 594

Note: Upper figures designate costs with stormwater, lower figures designate costs without stormwater except in combined sewer areas.

Table D-IV-C-31. ALTERNATIVE COSTS

ALTERNATIVE V
ADVANCED BIOLOGICAL-LAND TREATMENT COMBINATION PLAN
SLUDGE OPTION: LAND RECLAMATION
INTEREST RATE: 7.0%

Regional Management System Component	Capital Costs (w/o pr. worth) $ Million		Present Worth Costs $ Million				Average Annual Charge (Pr. worth basis) $ Million			
	First Year	Future Years	Capital	O & M	Repl.	Total	Capital	O & M	Repl.	Total
Treatment System	438 438	3938 3938	3289 3289	2044 1918	425 425	5758 5632	238 238	148 139	31 31	417 408
Conveyance System	310 295	1241 1180	1361 1294	80 78	11 8	1452 1381	99 94	6 6	1 1	105 100
Stormwater Mgmt. System	304 90	2278 793	2025 666	518 37	55 14	2597 717	146 48	38 3	4 1	187 52
Sludge Mgmt. System	29 29	265 265	222 222	72 72	81 81	375 375	16 16	5 5	6 6	27 27
Reuse System	83 82	578 574	527 524	136 134	8 8	672 665	38 38	10 10	1 1	49 48
Total:	1164 934	8301 6750	7423 5994	2850 2239	579 536	10853 8769	537 434	207 162	42 39	786 635

Note: Upper figures designate costs with stormwater, lower figures designate costs without stormwater except in combined sewer areas.

Table D-IV-C-32. ALTERNATIVE COSTS

ALTERNATIVE V
ADVANCED BIOLOGICAL-LAND TREATMENT COMBINATION PLAN
SLUDGE OPTION: LAND RECLAMATION
INTEREST RATE: 10.0%

Regional Management System Component	Capital Costs (w/o pr. worth) $ Million		Present Worth Costs $ Million				Average Annual Charge (Pr. worth basis) $ Million			
	First Year	Future Years	Capital	O & M	Repl.	Total	Capital	O & M	Repl.	Total
Treatment System	438 438	3938 3938	2958 2958	1233 1157	218 218	4409 4333	298 298	124 117	22 22	445 437
Conveyance System	310 295	1241 1180	1294 1230	49 47	5 4	1348 1281	130 124	5 5	1 0	136 129
Stormwater Mgmt. System	304 90	2278 793	1848 600	337 22	29 8	2213 630	186 60	34 2	3 1	223 63
Sludge Mgmt. System	29 29	265 265	199 199	44 44	41 41	284 284	20 20	4 4	4 4	29 29
Reuse System	83 82	578 574	484 481	82 81	4 4	571 565	49 49	8 8	0 0	58 57
Total:	1164 934	8301 6750	6783 5478	1744 1351	297 274	8824 7093	684 551	176 136	30 28	889 715

Note: Upper figures designate costs with stormwater, lower figures designate costs without stormwater except in combined sewer areas.

SPECIAL COST CONSIDERATIONS

General

This section outlines a number of special cost considerations associated with the costs reported on the individual alternative cost tables presented above.

The cost of connecting the 132 presently existing treatment facilities into the 64 regional treatment facilities which form the basis of the management system costs presented above are not included in these cost figures. However, an estimate of the capital cost for this interconnection has been made. The cost for the anticipated 2020 flow condition is approximately $28.8 million. This is consistent with the design and cost basis for the conveyance system presented in the cost tables.

The conveyance system was designed for 2020 flows to recognize the economies of scale inherent in the larger flows, and since it was assumed that the same treatment facilities would later be expanded to accept the increased flows.

The treatment system costs are based on treatment plant capacities to meet 1990 design flow conditions. The cost analysis assumes a 1990 level of flow to remain constant beyond 1990 and over the economic life of the system.

The land treatment capital cost figure includes only the land for lagoons purchased to provide aeration and storage for the 1990 level flows. The cost of the land treatment system does not include provisions for the loss of tax revenues associated with land areas used for the lagoon facilities. For alternatives IV and V, it is estimated that the annual tax loss on purchased land will be approximately $1.1 million and $0.3 million respectively.

The salvage value of existing treatment facilities which would be abandoned in the construction of any alternative is assumed equal to the cost of dismantling and scrapping these facilities. Abandoned plants are presented in Table D-II-B-1 as a function of alternatives. The associated land is assumed to be maintained in the same public ownership and is available for access points among other uses.

The bonded indebtedness associated with existing C-SELM plants has not been considered in this cost analysis due to the

lack of sufficient data together with the fact that this cost is relatively small when compared to the overall costs of the five alternative systems studied. Furthermore this incremental cost is common to all alternatives and thus it will not alter the economic rankings of these alternatives.

As presented in Appendix B, Section VI-A, the estimated total treatment plant bonded indebtedness is $401.5 million. However, there is a lack of data concerning interest rates and amortization periods for this money. Assuming an interest rate of 5-1/2 percent over 50 years, the increase in total average annual charge due to this indebtedness ranges from 12 percent for Alternative I down to 3 percent for Alternative III.

Rock and Residual Soil Management Systems

Three options have been discussed in Appendix B for the management of rock and soil materials from the construction of storage facilities, deep tunnel conveyance systems, and shallow conveyance systems. The cost for the five alternative wastewater management systems has been determined based upon making the maximum commercial use of the materials. The cost of material management has been included as a part of the construction cost of each component and involves a stockpiling and handling cost to provide for future commercial availability.

If the materials from the construction of the McCook-Summit storage basin are not used commercially, but are instead used to construct a mountain landscape in the southwest Cook County area, an additional $225 million capital expenditure would be required.

If, instead of commercial use, the materials from the McCook-Summit storage basin were used to construct recreational islands in Lake Michigan, $350 million in additional capital expenditures would be added to the basic cost of each alternative.

Reuse Systems

The reuse systems presented in Appendix B are designed for recreational-navigational reuse and potable reuse. Recreational-navigational reuse cost figures only are presented in the individual alternative cost tables presented above. The potable reuse system costs are wholly seperable cost items and are removed for this reason.

Table D-IV-C-33. POTABLE REUSE SYSTEM COSTS

Alternative-Interest Rate	Capital Costs (w/o pr. worth) $ Million		Present Worth Costs $ Million				Average Annual Charge (Pr. worth basis) $ Million			
	First Year	Future Years	Capital	O & M	Repl.	Total	Capital	O & M	Repl.	Total
II - 5.0%	0	266	161	59	9	229	9	3	1	13
Option 1	0	134	81	43	5	129	4	2	0	7
Option 2	0	123	74	19	3	96	4	1	0	5
	0	123	74	19	3	96	4	1	0	5
II - 5.5%	0	266	153	53	8	214	9	3	0	13
Option 1	0	134	77	38	4	120	5	2	0	7
Option 2	0	123	71	17	2	90	4	1	0	5
	0	123	71	17	2	90	4	1	0	5
II - 7.0%	0	266	132	38	5	176	10	3	0	13
Option 1	0	134	67	28	3	97	5	2	0	7
Option 2	0	123	61	13	1	75	4	1	0	5
	0	123	61	13	1	75	4	1	0	5
II - 10.0%	0	266	100	21	2	124	10	2	0	12
Option 1	0	134	51	15	1	67	5	2	0	7
Option 2	0	123	46	7	1	54	5	1	0	5
	0	123	46	7	1	54	5	1	0	5
III - 5.0%	0	266	161	59	9	229	9	3	1	13
Option 1	0	134	81	43	5	129	4	2	0	7
Option 2	0	123	74	19	3	96	4	1	0	5
	0	123	74	19	3	96	4	1	0	5
III - 5.5%	0	266	153	53	8	214	9	3	0	13
Option 1	0	134	77	38	4	120	5	2	0	7
Option 2	0	123	71	17	2	90	4	1	0	5
	0	123	71	17	2	90	4	1	0	5
III - 7.0%	0	266	132	38	5	176	10	3	0	13
Option 1	0	134	67	28	3	97	5	2	0	7
Option 2	0	123	61	13	1	75	4	1	0	5
	0	123	61	13	1	75	4	1	0	5
III - 10.0%	0	266	100	21	2	124	10	2	0	12
Option 1	0	134	51	15	1	67	5	2	0	7
Option 2	0	123	46	7	1	54	5	1	0	5
	0	123	46	7	1	54	5	1	0	5

Table D-IV-C-33. (Continued)

Alternative-Interest Rate	Capital Costs (w/o pr. worth) $ Million		Present Worth Costs $ Million				Average Annual Charge (Pr. worth basis) $ Million			
	First Year	Future Years	Capital	O & M	Repl.	Total	Capital	O & M	Repl.	Total
IV - 5.0%	0	269	162	59	10	231	9	3	1	13
	0	138	83	44	5	132	5	2	0	7
Option 1										
Option 2	0	123	74	19	3	96	4	1	0	5
	0	123	74	19	3	96	4	1	0	5
IV - 5.5%	0	269	155	53	8	216	9	3	0	13
	0	138	79	39	4	123	5	2	0	7
Option 1										
	0	123	71	17	2	90	4	1	0	5
Option 2	0	123	71	17	2	90	4	1	0	5
IV - 7.0%	0	269	134	38	5	178	10	3	0	13
	0	138	68	28	3	100	5	2	0	7
Option 1										
Option 2	0	123	61	13	1	75	4	1	0	5
	0	123	61	13	1	75	4	1	0	5
IV - 10.0%	0	269	101	21	2	125	10	2	0	13
	0	138	52	16	1	69	5	2	0	7
Option 1										
	0	123	46	7	1	54	5	1	0	5
Option 2	0	123	46	7	1	54	5	1	0	5
V - 5.0%	0	269	162	59	10	231	9	3	1	13
	0	138	83	44	5	132	5	2	0	7
Option 1										
	0	123	74	19	3	96	4	1	0	5
Option 2	0	123	74	19	3	96	4	1	0	5
V - 5.5%	0	269	155	53	8	216	9	3	0	13
	0	138	79	39	4	123	5	2	0	7
Option 1										
	0	123	71	17	2	90	4	1	0	5
Option 2	0	123	71	17	2	90	4	1	0	5
V - 7.0%	0	269	134	38	5	78	10	3	0	13
	0	138	68	28	3	100	5	2	0	7
Option 1										
	0	123	61	13	1	75	4	1	0	5
Option 2	0	123	61	13	1	75	4	1	0	5
V - 10.0%	0	269	101	21	2	125	10	2	0	13
	0	138	52	16	1	69	5	2	0	7
Option 1										
	0	123	46	7	1	54	5	1	0	5
Option 2	0	123	46	7	1	54	5	1	0	5

The potable reuse system cost figures are presented in Table D-IV-C-33, for Alternatives II through V. These costs are broken down for each of the two potable reuse options 1 and 2, associated with the 3200 cfs restriction on Illinois Lake Michigan withdrawal and no restriction on Illinois Lake Michigan withdrawal, respectively.

As was done in the individual alternative cost tables, two figures are reported for each cost item. The top figure reflects a with total stormwater analysis including separate stormwater while the bottom figure reflects a without separate stormwater or, combined stormwater only analysis.

The potable reuse system Option 1 was designed for the with separate stormwater analysis since reclaimed rural stormwater flows were utilized as an integral part of that reuse system together with reclaimed municipal and industrial (M & I) flows. For the without separate stormwater analysis, the costs associated with Option 1 of the potable reuse system were estimated in the following manner: The potable reuse system costs attributed to the collection and transmission of reclaimed rural stormwater flows were deleted. These rural reuse flows were made up by increasing the use of M & I flows. Therefore the cost estimate of the without stormwater analysis consisted of a linear increase in the costs associated with the M & I supply system for the with stormwater analysis.

The cost figures in Table D-IV-C-33 can be added to those of the individual alternative cost values of Tables D-IV-C-5 through D-IV-C-32 to determine the total management system cost with a potable reuse add-on.

Industrial Systems

All industrial wastewater flows, exclusive of the power industry flows, are assumed in the methodology of this study report to be tributary to regional treatment plants in order to accomplish the projected NDCP effluent goals. While this is a certainty for industries that are currently connected to regional treatment plants, it would undoubtedly be dictated by the relative economics of regional plant versus on-site NDCP

treatment for those industries currently treating on-site and discharging effluent directly to C-SELM surface waters. The following industrial treatment cost analysis deals with the present on-site treatment industries that constitute in excess of 90% of C-SELM industry and thereby reasonably approximates the total industrial C-SELM wastewater treatment costs within survey-scope precision. These on-site industries are identified as the critical industries, namely steel and petroleum, and the balance of the on-site industries are termed the noncritical industries.

Total annual costs on a modular basis for the steel and petroleum industries in the C-SELM area at different levels of treatment are presented in Appendix B. Wastewater flows for these and the noncritical industries are known for 1972 and have been projected for future years. The total annual cost determined on the basis of this information is summarized for the steel and petroleum industries in Tables D-IV-C-34 and D-IV-C-35, following the format of Tables B-VI-B-11 and B-VI-B-22.

The costs shown for a given year are based on a module of the same production size as in 1972. The flow projected for a given year divided by the discharge of a single module in that year determines the number of modules in operation. This number multiplied by the unit cost of treatment of a module provides the total annual cost to the entire industry for that level of treatment.

Table D-IV-C-36 summarizes the total annual costs to the noncritical industries for the various levels of treatment. These costs were determined by taking the weighted average of the cost to treat unit flows in the steel and petroleum treatment modules (weighted by volume discharged) and multiplying this by the total discharge flows of the noncritical industry segment.

A comparison of the treatment costs within a single industry for the various levels of treatment demonstrates that the anticipated increased costs of higher degrees of treatment are largely or completely mitigated by the cost decreases due to flow reduction brought about by increased recycle. The costs of on-site versus regional treatment for achieving the NDCP effluent goals can be seen as a function of the technology involved. With land treatment technology, a regional plant is favored while with advanced biological technology, on-site treatment appears to be favored. Physical-chemical technology experiences comparable costs at regional and on-site treatment facilities.

Finally, it is always more economic to proceed from current treatment practice directly to NDCP effluent goals without designing for current effluent standards as an intermediate goal. Depending once again on the technology, it is possible to reduce the annual cost of NDCP treatment from that of current practice with land treatment technology and increase the cost with advanced biological and physical-chemical technology.

Table D-IV-C-34

TOTAL ANNUAL COSTS OF DESIRED TREATMENT - STEEL INDUSTRY
(in 1972 thousand dollars)

Present Treatment

On-Site

Year	
1972	59,4[illegible]0,000
1990	60,9[illegible]6,000

Treatment for Current Standards

On-Site

Year	
1972	49,728,000
1990	50,971,000

Treatment for NDCP Standards

Year	Treatment	Cost of Prior Treatment	Cost of Regional Treatment	Total Cost
On-Site				
1972	Adv. Biol.	-	-	68,432,000
	Phys.-Chem.	-	-	68,448,000
1990	Adv. Biol.	-	-	70,142,000
	Phys.-Chem.	-	-	70,158,000
Regional				
1972	Adv. Biol.	41,104,000	34,752,000	75,856,000
	Phys.-Chem	41,104,000	26,912,000	68,016,000
	Land	41,104,000	20,400,000	61,504,000
1990	Adv. Biol.	42,132,000	35,620,000	77,752,000
	Phys.-Chem	42,132,000	27,584,000	69,716,000
	Land	42,132,000	20,910,000	63,042,000
Regional				
1972	Adv. Biol.	38,032,000	34,752,000	72,784,000
	Phys.-Chem	38,032,000	26,912,000	64,944,000
	Land	38,032,000	20,400,000	58,432,000
1990	Adv. Biol.	38,984,000	35,620,000	74,604,000
	Phys.-Chem	38,984,000	27,584,000	66,568,000
	Land	38,984,000	20,910,000	59,894,000

1972 DATA:

Discharge Flows	=	2635 MGD
No. of Modules	=	16.0
Flow per Module	=	164.3 MGD
Module Production	=	4110 Tons Day

1990 DATA:

Discharge Flows	=	203 MGD
No. of Modules		[illegible]4
Flow per Module	=	[illegible]2.4 MGD
Module Production	=	4110 Tons/Day

Table D-IV-C-35

TOTAL ANNUAL COSTS OF DESIRED TREATMENT - PETROLEUM INDUSTRY
(in 1972 thousand dollars)

Present Treatment

	On Site
1972	5,860,000
1990	69,617,000

Treatment for Current Standards

	On Site
1972	5,420,000
1990	64,390,000

Treatment for NDCP Standards

		Cost of Prior Treatment	Cost of Regional Treatment	Total Cost
		On Site		
1972	Adv. Biol.	-	-	7,910,000
	Phys.-Chem	-	-	7,780,000
1990	Adv. Biol.	-	-	93,971,000
	Phys.-Chem	-	-	92,426,000
		Regional		
1972	Adv. Biol.	3,440,000	3,500,000	6,940,000
	Phys.-Chem	3,440,000	2,710,000	6,150,000
	Land	3,440,000	2,060,000	5,500,000
1990	Adv. Biol.	40,867,000	41,580,000	82,447,000
	Phys.-Chem	40,867,000	32,195,000	73,062,000
	Land	40,867,000	24,472,000	65,340,000
		Regional		
1972	Adv. Biol.	2,860,000	3,500,000	6,360,000
	Phys.-Chem	2,860,000	2,710,000	5,570,000
	Land	2,860,000	2,060,000	4,920,000
1990	Adv. Biol.	33,977,000	41,580,000	75,557,000
	Phys.-Chem	33,977,000	32,195,000	66,172,000
	Land	33,977,000	24,472,000	58,449,000

1972 DATA:

Discharge Flows	=	219 MGD
No. of Modules	=	5
Flow per Module	=	44 MGD
Module Production	=	100,000 bpsd

1990 DATA:

Discharge Flows	=	238 MGD
No. of Modules	=	59.4
Flow per Module	=	4 MGD
Module Production	=	100,000 bpsd

Table D-IV-C-36

TOTAL ANNUAL COSTS OF DESIRED TREATMENT - NON-CRITICAL INDUSTRIES
(in 1972 thousand dollars)

Present Treatment

On-Site	
1972	3,211,000
1990	30,991,000

Treatment for Current Standards

On-Site	
1972	7,044,000
1990	26,583,000

Treatment for NDCP Standards

		Cost of Prior Treatment	Cost of Regional Treatment	Total Cost
On-Site				
1972	Adv. Biol.	-	-	9,845,000
	Phys.-Chem	-	-	9,803,000
1990	Adv. Biol.	-	-	37,155,000
	Phys.-Chem	-	-	36,996,000
Regional				
1972	Adv. Biol.	5,473,000	4,825,000	10,298,000
	Phys.-Chem	5,473,000	3,737,000	9,210,000
	Land	5,473,000	2,834,000	8,307,000
1990	Adv. Biol.	20,654,000	18,213,000	38,867,000
	Phys.-Chem	20,654,000	14,104,000	34,758,000
	Land	20,654,000	10,698,000	31,352,000
Regional				
1972	Adv. Biol.	4,955,000	4,825,000	9,780,000
	Phys.-Chem	4,955,000	3,737,000	8,692,000
	Land	4,955,000	2,834,000	7,790,000
1990	Adv. Biol.	18,701,000	18,213,000	36,914,000
	Phys.-Chem	18,701,000	14,104,000	32,805,000
	Land	18,701,000	10,698,000	29,399,000

1972 DATA:

Discharge Flows	=	219 MGD
No. of Modules	=	5
Flow per Module	=	350 MGD
Module Production	=	100,000 bpsd

1990 DATA:

Discharge Flows	=	238 MGD
No. of Modules	=	59.4
Flow per Module	=	104 MGD
Module Production	=	100,000 bpsd

TECHNICAL APPENDIX D

V. COMPARISON OF REGIONAL WASTEWATER MANAGEMENT ALTERNATIVES

V. COMPARISON OF REGIONAL WASTEWATER MANAGEMENT ALTERNATIVES

A. COST COMPARISON

GENERAL

Introduction

Presented in this section is a comparison and analysis of the alternative management system costs which are shown in the cost tables of Appendix D, Section IV-C. In order to facilitate alternative and component cost comparisons, a brief description of the effects of different interest rates, stormwater analyses and sludge management options on the cost analyses is presented in this general section. The remaining detailed cost comparisons will be made for the present worth cost analysis which reflects the present interest rates equal to 5.5% and which includes the treatment of all stormwater (with stormwater analysis), thus reflecting the NDCP water quality goal of this study. The agricultural utilization sludge option is used in the alternative comparisons since this is the only sludge management option which is common to all five alternatives studied in this report. The present worth analysis is used for comparative purposes since it best reflects the alternative costs incurred with the implementation schedule.

Interest Rates

As presented in the previous section, costs are analyzed using four different interest rates. Inspection of these alternative costs reveals that as the interest rate increases for a particular alternative, the present worth cost decreases. However, when costs are analyzed as average annual charges, the total alternative costs increase as the interest rate increases. This general costing trend which is common to all alternatives can be explained by studying the type of expenditures which comprise the total alternative costs. The present worth costs are less for those expenditures which occur during the latter portion of the economic life of the system. For higher interest rates, the cost discounts are more pronounced for late expenditures. Thus, capital expenditures reflect minor present worth cost decreases for increasing interest rates since these funds

are spent during the construction stage or the initial economic life of the system. After completion of these construction works, the operation and maintenance costs and replacement costs are expended throughout the remaining economic life of the system. Thus, these expenditures reflect more pronounced cost decreases in the present worth analysis for higher interest rates.

The average annual charge is computed by taking the present worth cost and amortizing this cost over the 50 year economic life of the system. Thus, the higher the interest rate, the more the amortized or average annual charge. For O & M and replacement costs, the decreased present worth cost for higher interest rates offsets the increase in amortized costs for the same rates. The overall effect is a minor decrease in average annual costs for increasing interest rates. On the other hand, the minor decrease in present worth capital costs for increasing interest rates is offset by the increases in amortizing these costs for the same rates. The net effect on a total alternative cost basis is that the capital expenditures offset the O & M and replacement costs and thus, average annual charges increase with increasing interest rates.

When comparing alternatives, higher interest rates will economically favor Alternatives II & III since O & M costs are large in contrast to their capital costs. The lower interest rates favor Alternative IV since the capital expenditures are large when compared to their O & M and replacement costs.

With vs. Without Stormwater

All costs presented in the previous section include a with and without stormwater analysis, except for Alternative I which is analyzed for without stormwater only. For the with stormwater analysis essentially all stormwater which runs off the C-SELM study area is retained and eventually treated. For the without stormwater analysis, the only runoff that is treated is that which is generated within the combined sewered C-SELM service areas. However, the regional conveyance systems and AWT plants are designed with capacities such that the eventual phasing in of all stormwater runoff may be accomplished.

The capital and replacement costs for the physical-chemical and the advanced biological treatment facilities decrease slightly in the without stormwater analysis since the capacity of certain treatment components is decreased due to the peaking applicability factor as discussed in Appendix B, Section IV-A. The capital costs for the land treatment facilities of Alternative IV do not change

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Interest Rates

As presented in the previous section, costs are analyzed using four different interest rates. Inspection of these alternative costs reveals that as the interest rate increases for a particular alternative, the present worth cost decreases. However, when costs are analyzed as average annual charges, the total alternative costs increase as the interest rate increases. This general costing trend which is common to all alternatives can be explained by studying the type of expenditures which comprise the total alternative costs. The present worth costs are less for those expenditures which occur during the latter portion of the economic life of the system. For higher interest rates, the cost discounts are more pronounced for late expenditures. Thus, capital expenditures reflect minor present worth cost decreases for increasing interest rates since these funds

are spent during the construction stage or the initial economic life of the system. After completion of these construction works, the operation and maintenance costs and replacement costs are expended throughout the remaining economic life of the system. Thus, these expenditures reflect more pronounced cost decreases in the present worth analysis for higher interest rates.

The average annual charge is computed by taking the present worth cost and amortizing this cost over the 50 year economic life of the system. Thus, the higher the interest rate, the more the amortized or average annual charge. For O & M and replacement costs, the decreased present worth cost for higher interest rates offsets the increase in amortized costs for the same rates. The overall effect is a minor decrease in average annual costs for increasing interest rates. On the other hand, the minor decrease in present worth capital costs for increasing interest rates is offset by the increases in amortizing these costs for the same rates. The net effect on a total alternative cost basis is that the capital expenditures offset the O & M and replacement costs and thus, average annual charges increase with increasing interest rates.

When comparing alternatives, higher interest rates will economically favor Alternatives II & III since O & M costs are large in contrast to their capital costs. The lower interest rates favor Alternative IV since the capital expenditures are large when compared to their O & M and replacement costs.

With vs. Without Stormwater

All costs presented in the previous section include a with and without stormwater analysis, except for Alternative I which is analyzed for without stormwater only. For the with stormwater analysis essentially all stormwater which runs off the C-SELM study area is retained and eventually treated. For the without stormwater analysis, the only runoff that is treated is that which is generated within the combined sewered C-SELM service areas. However, the regional conveyance systems and AWT plants are designed with capacities such that the eventual phasing in of all stormwater runoff may be accomplished.

The capital and replacement costs for the physical-chemical and the advanced biological treatment facilities decrease slightly in the without stormwater analysis since the capacity of certain treatment components is decreased due to the peaking applicability factor as discussed in Appendix B, Section IV-A. The capital costs for the land treatment facilities of Alternative IV do not change

between the two cost analysis since no peaking applicability factors are designed into the land treatment technology. The O & M costs for these three treatment technologies all decrease in the without stormwater analysis, since the total 1990 design flow to be treated is some 90% of that treated in the with stormwater analysis.

The capital and O & M costs decrease slightly in the without stormwater analysis for the conveyance system. This is due to the fact that the conveyance system which incorporates the suburban stormwater management system into the regional treatment facilities or access points is not included in these costs. The replacement costs for the conveyance system in the without stormwater analysis decrease some 30% since these costs reflect pumping facilities whose costs are proportionately high in the suburban stormwater conveyance system.

All costs associated with the stormwater management system greatly decrease in the without stormwater analysis since the suburban and rural stormwater management components are not included in this analysis.

All costs associated with the sludge management system are the same for both the with and without stormwater analysis. This is due to the fact that the grit associated with the incremental stormwater treated in the with stormwater analysis is retained and disposed of in the stormwater management system.

Finally, the without stormwater costs for the reuse system are slightly less than the with stormwater costs. This is due to the exclusion of the wet weather reclaimed water transfers between the major C-SELM streams in the without stormwater analysis.

Sludge Management Options

For Alternatives III through V, two sludge management options are considered. In Option 1 the sludge is applied to rural lands adjoining the C-SELM service area for agricultural utilization purposes. The second option involves the utilization of stripped mined areas for applying large quantities of sludge to reclaim these lands which are located at significant distances from the study area.

The capital and replacement costs for the agricultural utilization option are significantly less than the land reclamation option. A major factor is the increased transportation costs associated with Option 2. Also the land reclamation application system is not a fixed system and is utilized over five to six times the area which is required by the

agricultural utilization application system. Even though land payments equivalent to the market value of the rural land are included in Option 1 (land payments are not included in Option 2) the capital replacement and O & M costs are greater for the land reclamation option.

COMPARISON OF ALTERNATIVES

Alternative I Costs

The total present worth cost for Alternative I is 3.4 billion dollars or approximately 27% of the cost of the physical-chemical and advanced biological treatment plans and some 35% of the cost of the land treatment plan.

The total treatment system cost for this reference plan is some 20% of the treatment costs for the advanced wastewater treatment plant systems and approximately 37% of the land treatment facility costs. This reflects the decreased unit capital and O & M treatment costs for the achievement of present effluent standards as contrasted with the more costly AWT technologies utilized for the achievement of the NDCP standard. Also, Alternative I is costed for the without stormwater analysis and thus treatment facility flows are 10% less than the AWT systems.

The conveyance and stormwater management system costs for this alternative are associated with the collection tunnels and storage facilities of the Chicago Underflow Plan together with the stormwater conveyance and storage facilities of all other C-SELM combined sewered areas.

The sludge management costs for this alternative are associated with the agricultural utilization of MSDGC sludge to Fulton County, Illinois as is presently practiced. The remaining sludge is applied to nearby agricultural lands adjacent to the C-SELM service area. The total present worth sludge management costs for this alternative is 33% more expensive than a comparable management system for Alternative III. This cost increase is primarily due to the sludge transportation costs to Fulton County which exceed pipeline transmission costs to nearby agricultural lands.

Alternative II Costs

The total present worth cost of this physical-chemical treatment plan is 12.4 billion dollars. The total treatment system cost accounts for some 60% of the total Alternative II costs. Both the

capital and O & M costs are some 3.3 billion dollars.

The conveyance system cost for Alternative II is some 10% more expensive than comparable costs for Alternative I. This cost reflects additional regional wastewater conveyance lines which incorporate 31 abandoned facilities into a 33 plant system. The costs also reflect the integration of stormwater conveyance lines from separate sewer suburban storage facilities into the regional wastewater conveyance system.

The stormwater management system costs increase from the 0.7 billion Alternative I cost to some 2.8 billion dollars. This cost increase reflects the without versus with stormwater analysis. The additional 2.1 billion dollars is attributed to the rural stormwater management system (60%) and the separate sewer suburban storage facilities (40%).

The physical-chemical sludge management system is approximately 1.3 billion dollars or some four times as expensive as Alternative I. Although the sludge transportation cost is less costly for Alternative II the application system and land costs are much greater than Alternative I. This cost increase is primarily due to the small physical-chemical sludge application rate which requires vast application areas.

The reuse system cost reflects a reuse reclaimed water conveyance system from the physical-chemical treatment facilities to selected injection points located on C-SELM water courses. The purpose of this reuse system is to maintain base flows in the C-SELM streams for recreational and navigational purposes.

Alternative III Costs

The total present worth cost for Alternative III, the advanced biological treatment plan is 12.7 billion dollars or some 2% greater that the physical-chemical treatment plan.

The total treatment system cost for this alternative is 8.4 billion dollars which is some 20% more expensive than the physical-chemical treatment facilities. Even though credit is given to the existing secondary C-SELM facilities which are incorporated into this 17 plant system, the capital and replacement costs account for these increased treatment facility costs. The O & M treatment plant costs are less for this alternative than for the physical-chemical system due to economies of scale of this 17 plant scheme as compared to the previous 33 plant alternative.

The conveyance system cost for this 17 plant regional system is 1.0 billion dollars. This is an increase of some 57 million dollars over Alternative II which reflects the additional conveyance cost for the treatment plant regionalization of a 33 plant system to a 17 plant layout.

The stormwater management system facilities and hence costs for this alternative are identical to the Alternative II system.

The total sludge management system cost for this alternative is some 0.3 billion dollars or 20% of the Alternative II sludge cost. The capital, O & M and replacement costs are decreased for this system since the advanced biological sludge application rate is much greater than that for the physical-chemical system. Thus, the land requirements and costs are greatly decreased. The sludge application system for this plan is a permanent installation which is another factor in the decreased cost of this system. This decrease in sludge costs essentially effects the increased treatment facility costs thereby creating a cost tradeoff between the advanced biological and physical-chemical treatment plans.

The reuse system cost for this alternative is slightly less than the cost for Alternative II. The reason for this is that the reuse injection points were designed based on this 17 plant alternative and thus, the length of the reuse conveyance system for this alternative is less than that for Alternative III.

Alternative IV Costs

The total present worth cost of the land treatment plan is some 9.7 billion dollars. This is equivalent to 77% of the cost of the advanced biological treatment plan.

The treatment system cost for this alternative is 3.7 billion. This cost is equivalent to 51% of the physical-chemical treatment costs and 43% of the advanced biological treatment costs. From a capital, O & M, replacement and total present worth cost analysis, the land treatment technology is the least cost AWT system designed for the attainment of the NDCP water quality goals.

The conveyance system for this alternative is 1.9 billion dollars which is equivalent to an 81% increase in conveyance costs over the Alternative III system. This increase in cost is necessitated by the fact that the land system utilizes large tracts of rural land located outside the study area. The difference in costs between these

two Alternatives is some 0.9 billion dollars which reflects the additional land treatment conveyance system.

There is a 2% increase in the cost of the stormwater management system of this plan over that for Alternatives II & III. This increase is due to storage facilities located at the access points of the regional conveyance system. These storage facilities are utilized to modulate peak diurnal wastewater flow or infiltrated stormwater flows. These storage facilities were designed and costed into Alternatives II and III under the treatment system component.

The sludge system cost for the land treatment plan is 0.1 billion dollars or some 38% of the comparable costs for Alternative III. The major reason for this decrease in cost is that the sludge application areas are adjacent to the land treatment storage lagoons. Since the sludge solids are conveyed to the land site in the wastewater conveyance system, there are minimal transportation costs associated with the land treatment sludge system.

The total reuse system cost for the land treatment plan is approximately 1.2 billion dollars. The reuse system cost for Alternative III is some 0.1 billion dollars. This large increase in the land system cost is due to the fact that reclaimed water reuse tunnels and pumping facilities are designed into Alternative IV to retain high quality waters to the same water course injection points as designed in Alternative III.

Alternative V Costs

Alternative V is an advanced biological-land treatment combination plan. Thus, the costs for the various system components lie between the advanced biological plan, Alternative III and the land treatment plan, Alternative IV. Since 79% of the total flows are treated utilizing the advanced biological treatment technology, the Alternative V costs are more closely associated with Alternative III. The total present worth cost of this plan is 12.2 billion dollars which is some 96% of the cost of Alternative III and 125% of the cost of Alternative IV.

SUMMARY OF ALTERNATIVE COSTS

Presented in Table D-V-A-1 are summary cost data for the five alternative wastewater management systems studied in this report. This table includes present worth costs, average annual charges and 1990 annual costs for capital, O & M, replacement and total system costs on a straight dollar basis and a unit flow basis. The costs are also

Table D-V-A-1

SUMMARY TABLE
ALTERNATIVE COST COMPARISON

	ITEM	ALTERNATIVE I Costs $	ALTERNATIVE I Costs/MG $/MG	ALTERNATIVE II Costs $	ALTERNATIVE II Costs/MG $/MG	ALTERNATIVE III Costs $	ALTERNATIVE III Costs/MG $/MG	ALTERNATIVE IV Costs $	ALTERNATIVE IV Costs/MG $/MG	ALTERNATIVE V Costs $	ALTERNATIVE V Costs/MG $/MG
Present Worth Cost	Capital	0 (2,627)	0 (68.8)	7,254 (5,685)	158.9 (140.3)	7,721 (6,129)	169.1 (151.2)	6,866 (5,372)	150.4 (132.6)	7,719 (6,225)	169.0 (153.6)
	O & M	0 (468)	0 (11.5)	4,324 (3,327)	94.7 (82.1)	4,032 (3,046)	88.3 (75.2)	2,584 (1,827)	56.6 (45.1)	3,752 (2,961)	82.2 (73.1)
	Repl.	0 (278)	0 (6.8)	788 (683)	17.3 (16.9)	913 (802)	20.0 (19.8)	299 (238)	6.5 (5.9)	742 (681)	16.3 (16.8)
	Total	0 (3,372)	0 (83.2)	12,366 (9,694)	270.8 (239.2)	12,666 (9,977)	277.4 (246.2)	9,749 (7,437)	213.5 (183.5)	12,214 (9,866)	267.5 (243.4)
Average Annual Charge	Capital	0 (155)	0 (3.8)	428 (336)	9.4 (8.3)	456 (362)	10.0 (8.9)	406 (317)	8.9 (7.8)	456 (368)	10.0 (9.1)
	O & M	0 (28)	0 (0.7)	255 (197)	5.6 (4.9)	238 (180)	5.2 (4.4)	153 (108)	3.4 (2.7)	222 (175)	4.9 (4.3)
	Repl.	0 (16)	0 (0.4)	47 (40)	1.0 (1.0)	54 (47)	1.2 (1.2)	18 (14)	0.4 (0.3)	44 (40)	1.0 (1.0)
	Total	0 (199)	0 (4.9)	730 (573)	16.0 (14.1)	748 (589)	16.4 (14.5)	576 (439)	12.6 (10.8)	721 (583)	15.8 (14.4)
1990, Annual Cost	Capital	0 (188.3)	0 (4.6)	525.0 (414.4)	11.5 (10.2)	559.2 (446.9)	12.2 (11.0)	487.6 (382.6)	10.7 (9.4)	553.1 (448.1)	12.1 (11.1)
	O & M	0 (42.3)	0 (1.0)	381.1 (300.7)	8.3 (7.4)	354.7 (275.3)	7.8 (6.8)	258.8 (199.8)	5.7 (4.9)	329.4 (267.5)	7.2 (6.6)
	Repl.	0 (16)	0 (0.4)	47 (40)	1.0 (1.0)	54 (47)	1.2 (1.2)	18 (14)	0.4 (0.3)	44 (40)	1.0 (1.0)
	Total	0 (246.6)	0 (6.0)	953.1 (755.1)	20.8 (18.6)	967.9 (769.2)	21.2 (19.0)	764.4 (596.4)	16.8 (14.6)	926.5 (755.6)	20.3 (18.7)

Note: Costs are based on an interest rate equal to 5.5% over a 50-year period.

presented for the with and without stormwater analysis. In all cases, the reference plan which is designed to meet current effluent standards is the least costly alternative. Of the remaining four alternatives which are designed to meet the NDCP water quality goals, Alternative IV, the land treatment plan, is the least costly followed by Alternatives V, II and III. These cost trends are the same regardless of the cost analysis utilized and presented in Table D-V-A-1.

V. COMPARISON OF REGIONAL WASTEWATER MANAGEMENT ALTERNATIVES

B. WATER RESOURCE

GENERAL

The purpose of this section is to present the impact of each of the regional wastewater management alternatives on the utilization and movement of the water resource of the C-SELM area. To this end two analyses have been performed.

The first deals with the movement of the water resource under the influence of each individual alternative. This has been accomplished through a water balance diagram. The concept behind its use is presented in Appendix B, Section IV-G. The water balances for each alternative are presented below.

The second form of analysis deals with the impact of the flows for recreational-navigational reuse and the overflows from the specific alternative treatment system. This analysis is directly tied into the recreational-navigational reuse study and flow determination presented in Appendix B, Section IV-G. A discussion of this impact follows.

ALTERNATIVE MANAGEMENT SYSTEM WATER BALANCES

Water balances reflect the movement of the total water resource under the influence of any specific alternative. The water resource in this analysis includes:

1. Municipal and industrial supplies and supply sources which include:
   a) Lake Michigan
   b) Groundwater
   c) Rural Stormwater
   d) M & I Reuse
2. Municipal and industrial supply system losses.
3. Untreated wastewater flows.
4. Direct collection of urban and suburban stormwater

5. Infiltration of urban and suburban stormwater
6. Reuse flows, including
    a) recreational
    b) municipal and industrial
7. Treatment system effluent discharge
8. Rural stormwater flows

Each of these flows has been identified on the water balances and quantified.

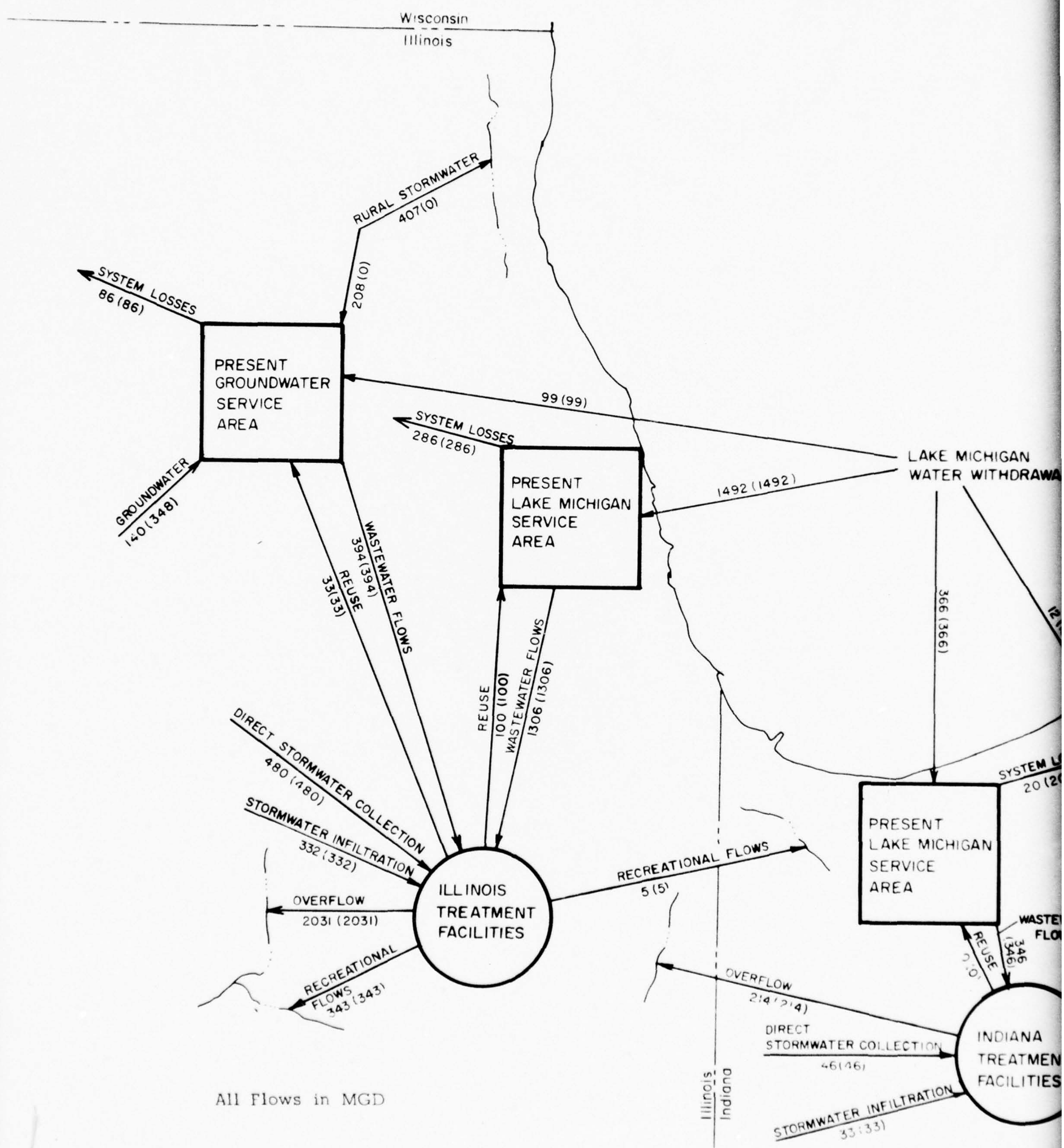
The water balances are conceptually the same for each alternative as they each present three key elements: Two Present Water-Use service areas defined as 1) Present Lake Michigan Service Area and 2) Present Groundwater Service Area; and 3) the treatment facility. A system of flow indicators trace the movement of the flow between these key elements.

There are two water balance diagrams for each alternative. One reflects Option 1 of the potable reuse system, the other, Option 2 of the potable reuse system. Option 1 reflects the 3200 CFS restriction on Illinois Lake Michigan withdrawal while Option 2 reflects no like restriction.

Figure D-V-B-1 presents the water balance for Alternatives II and III, Option 1. Figure D-V-B-2 presents the water balance for Alternatives II and III, Option 2. Figure D-V-B-3 and D-V-B-4 present the Water Balance for Alternative IV, options 1 and 2, respectively. Figure D-V-B-5 and D-V-B-6 present the Water Balances for Alternative V, Options 1 and 2, respectively.

The eight water resource items described above are presented on the balance diagrams. Flows on the balance diagrams reflect summer and winter flow values, with the winter flows appearing in parenthesis. They also include dissemenations between Illinois and Indiana. The flow values reflect average daily flows with stormwater. Summer flows reflect a conceptual eight month period, winter flows a four month period.

Direct and infiltrated stormwater collection do not reflect, however, the summer winter flow variation since no means of descriminiation were available. Rural stormwater flows reflect the summer-winter variation since they are regulated through the rural stormwater management system which operates on a seasonal basis.



All Flows in MGD

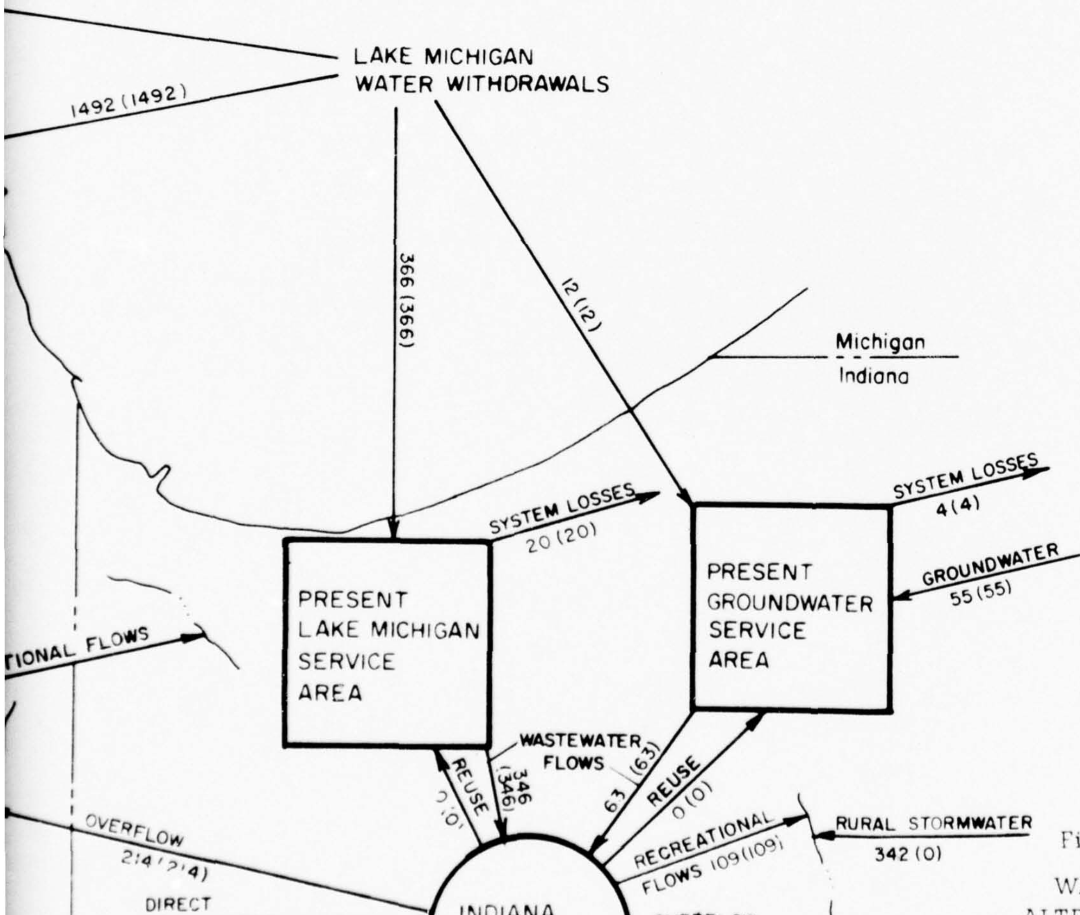
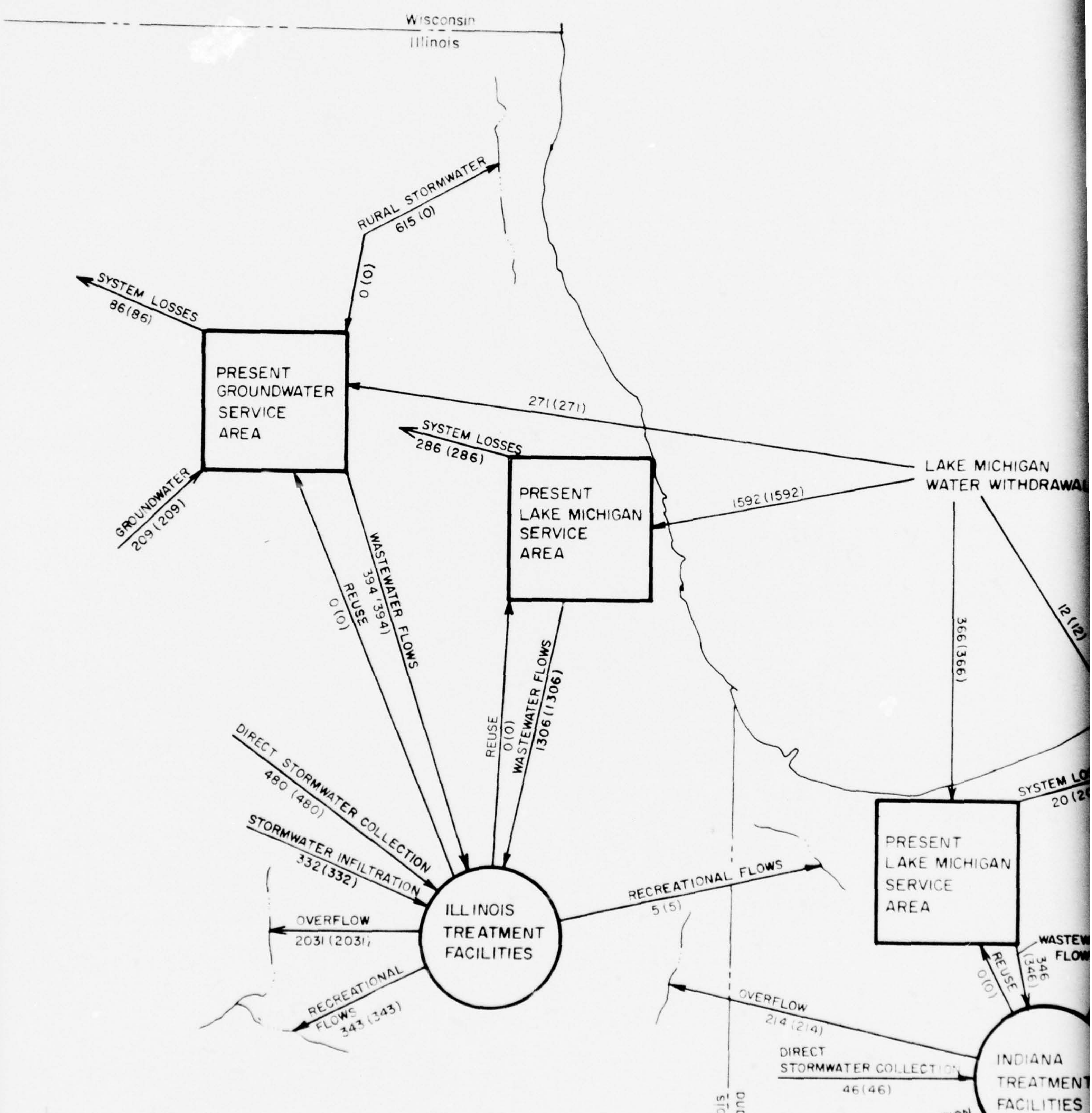


Figure D-V-B-1

WATER BALANCE
ALTERNATIVES II & III
OPTION 1 - 1990 - SUMMER(WINTER)
3200 CFS RESTRICTION
ILLINOIS, LAKE MICHIGAN WITHDRAWAL


Wisconsin
Illinois
RURAL STORMWATER
615 (0)
0 (0)
SYSTEM LOSSES
86 (86)
PRESENT GROUNDWATER SERVICE AREA
271 (271)
GROUNDWATER
209 (209)
SYSTEM LOSSES
286 (286)
PRESENT LAKE MICHIGAN SERVICE AREA
LAKE MICHIGAN
WATER WITHDRAWAL
1592 (1592)
WASTEWATER FLOWS
394 (394)
REUSE
0 (0)
REUSE
0 (0)
WASTEWATER FLOWS
1306 (1306)
366 (366)
12 (12)
DIRECT STORMWATER COLLECTION
480 (480)
STORMWATER INFILTRATION
332 (332)
OVERFLOW
2031 (2031)
ILLINOIS TREATMENT FACILITIES
RECREATIONAL FLOWS
5 (5)
RECREATIONAL FLOWS
343 (343)
SYSTEM LO
20 (2
PRESENT LAKE MICHIGAN SERVICE AREA
REUSE
0 (0)
WASTEW FLOW
346 (346)
OVERFLOW
214 (214)
DIRECT
STORMWATER COLLECTION
46 (46)
INDIANA TREATMENT FACILITIES
STORMWATER INFILTRATION
33 (33)
Illinois
Indiana
All Flows in MGD

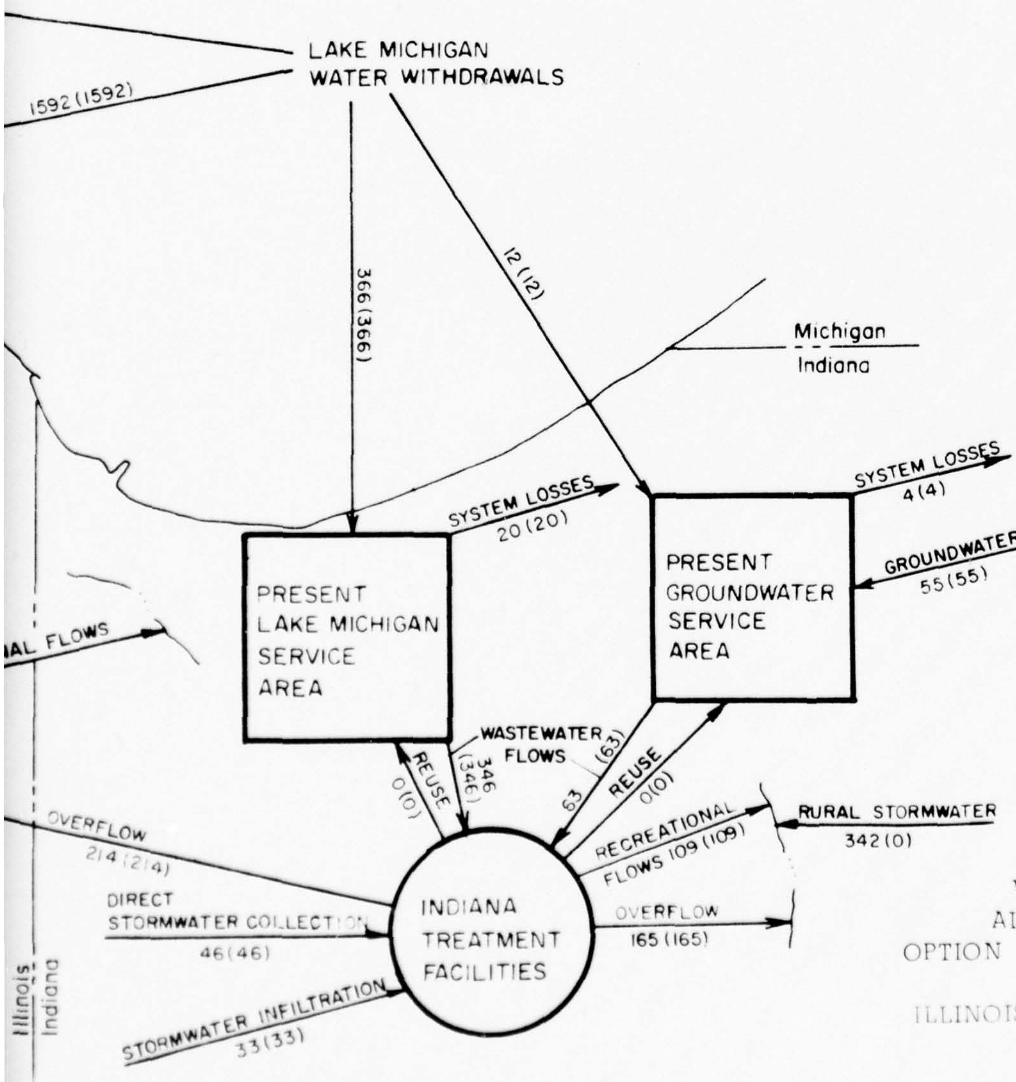
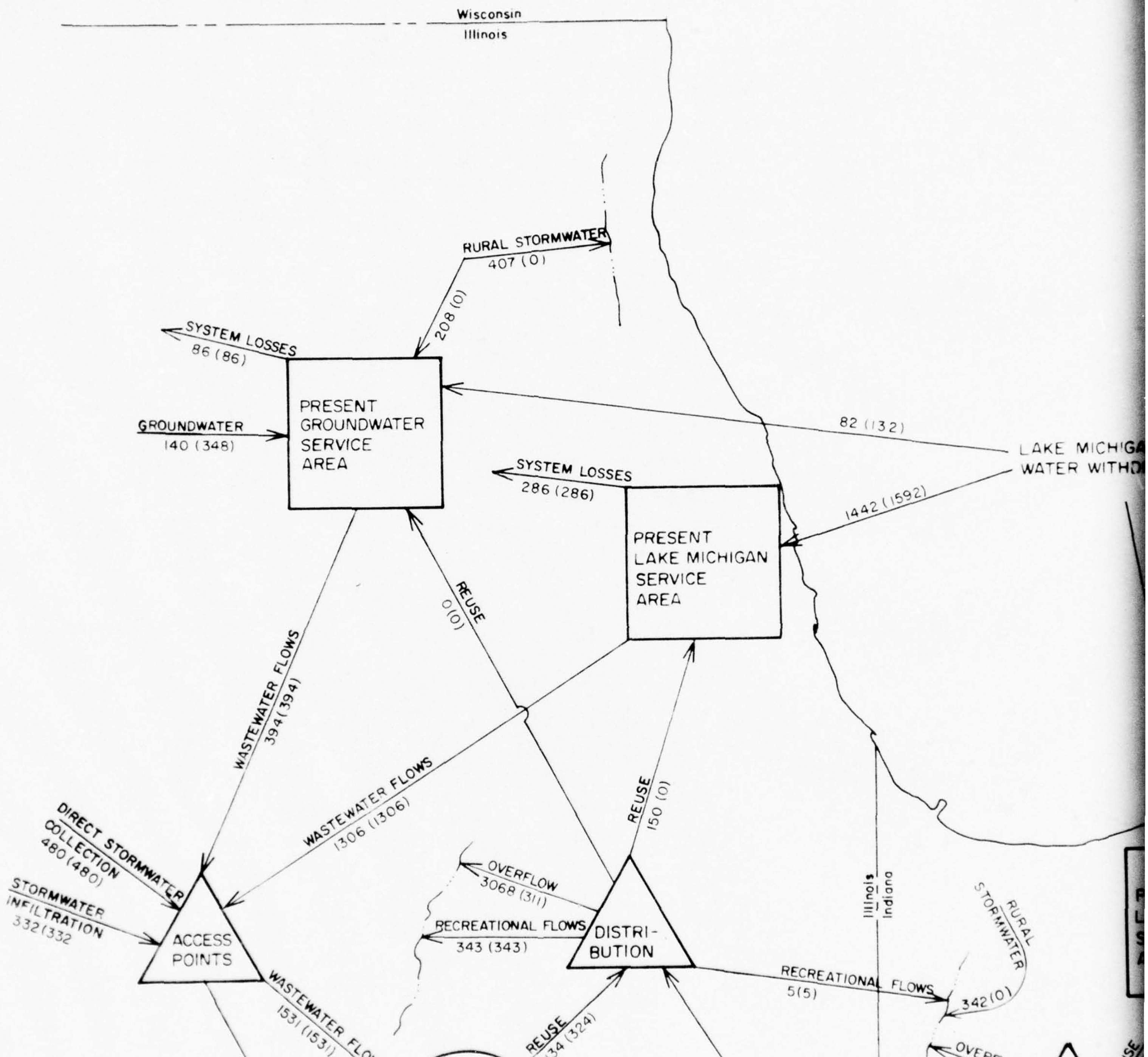


Figure D-V-B-2

WATER BALANCE
ALTERNATIVES II & III
OPTION 2 - 1990 - SUMMER(WINTER)
NO RESTRICTION
ILLINOIS, LAKE MICHIGAN WITHDRAWAL



All Flows in MGD

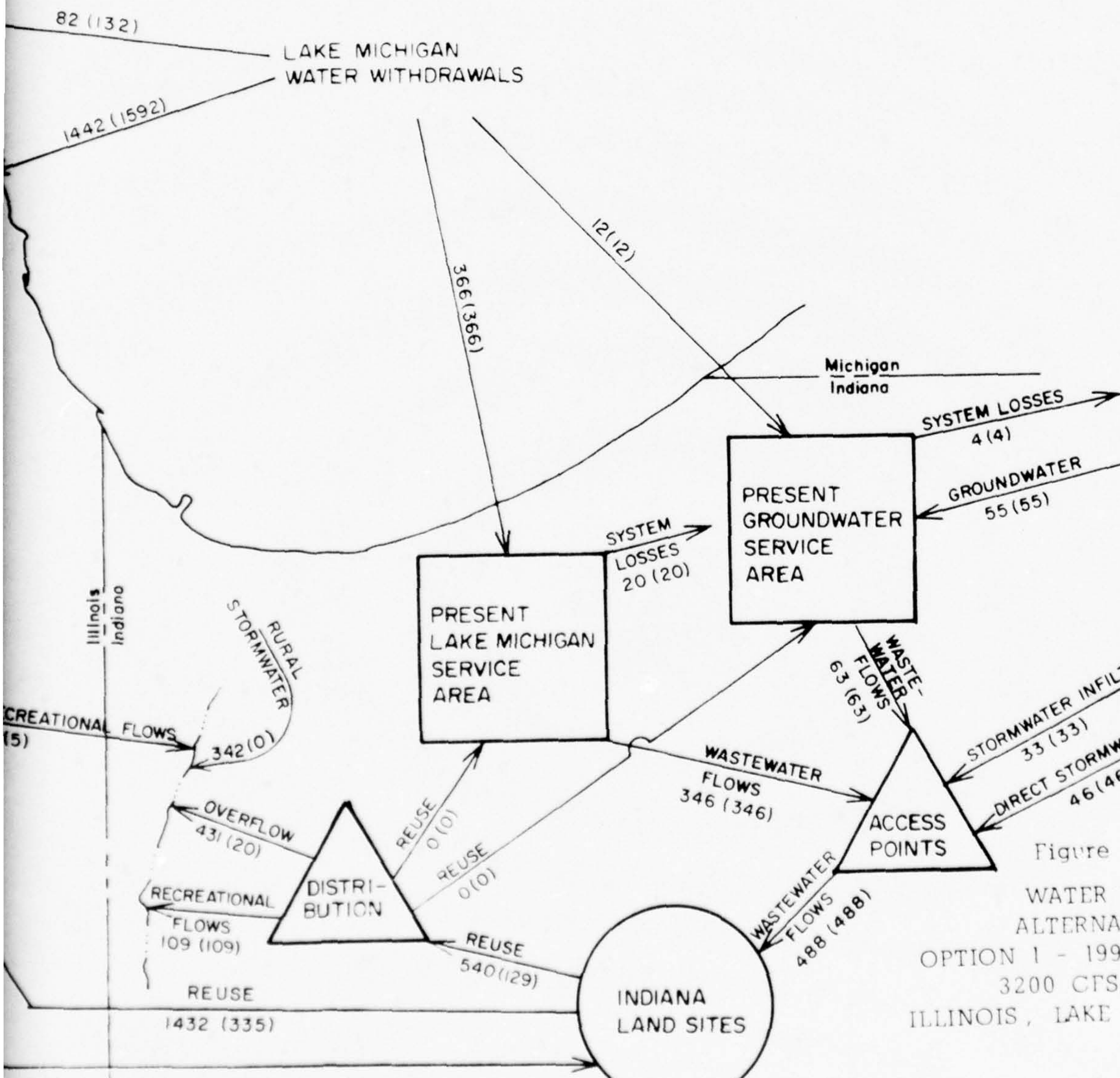
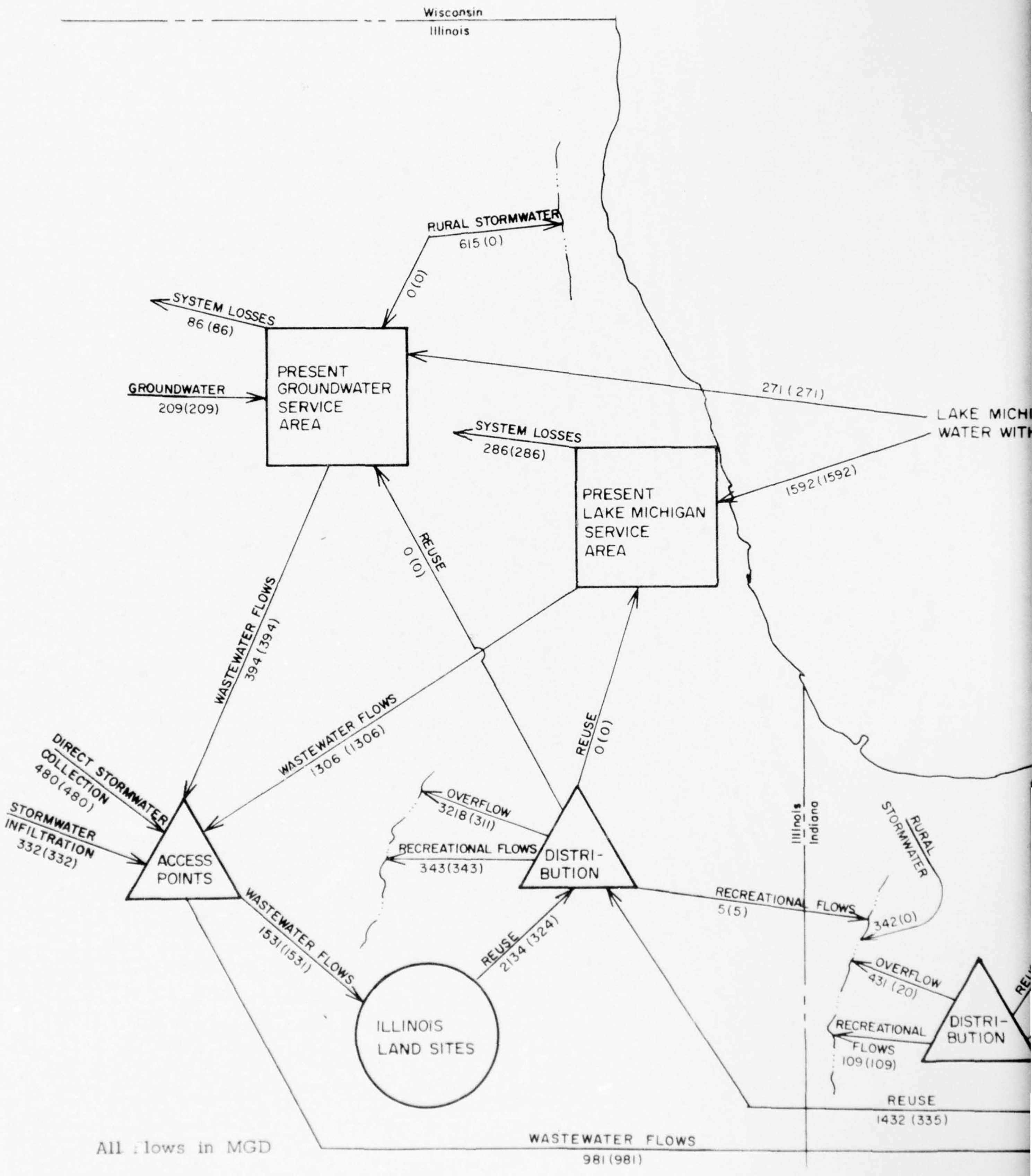


Figure D-V-B-3

WATER BALANCE
ALTERNATIVE IV
OPTION 1 - 1990 - SUMMER(WINTER)
3200 CFS RESTRICTION
ILLINOIS, LAKE MICHIGAN WITHDRAWAL



All Flows in MGD

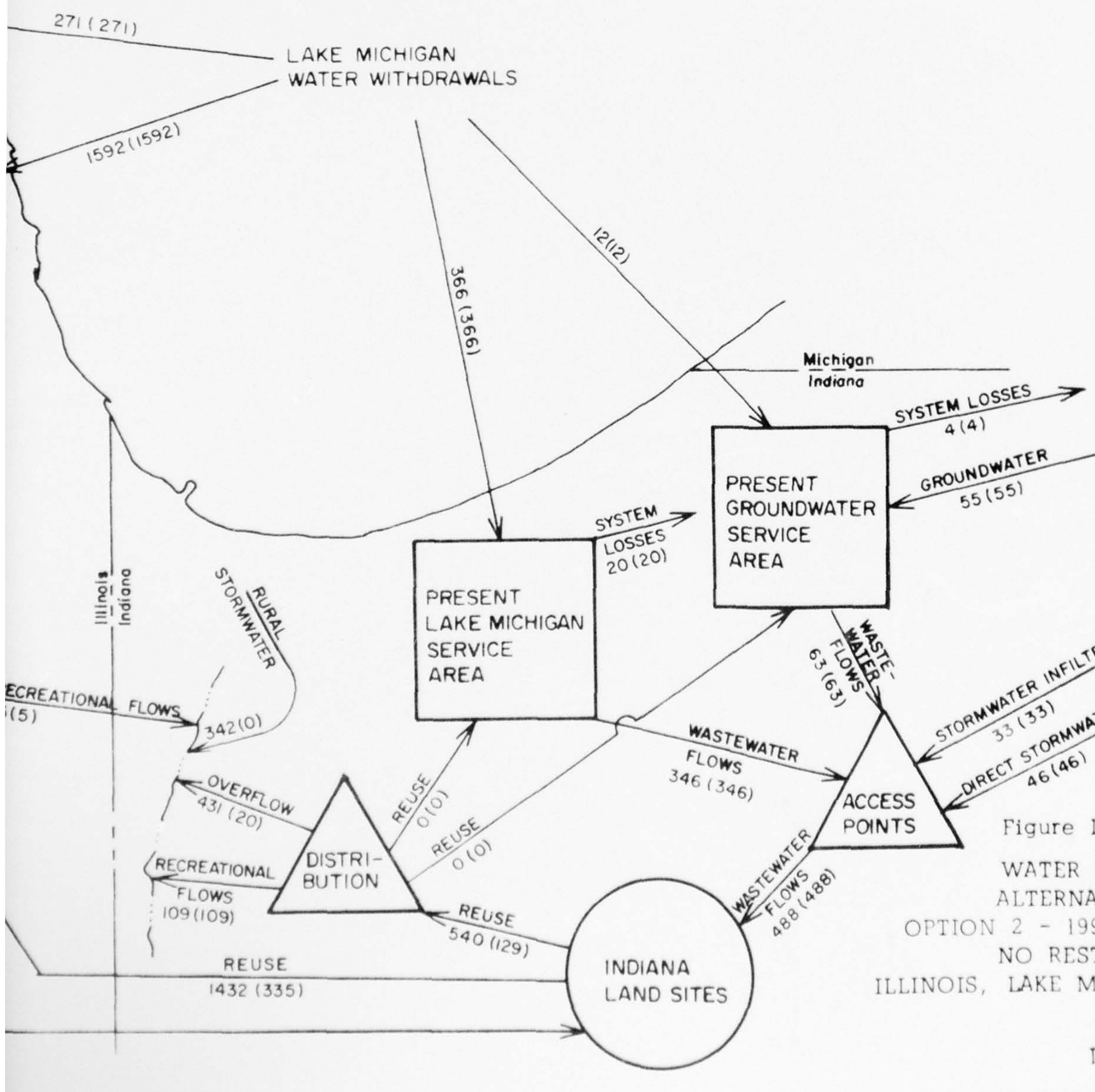
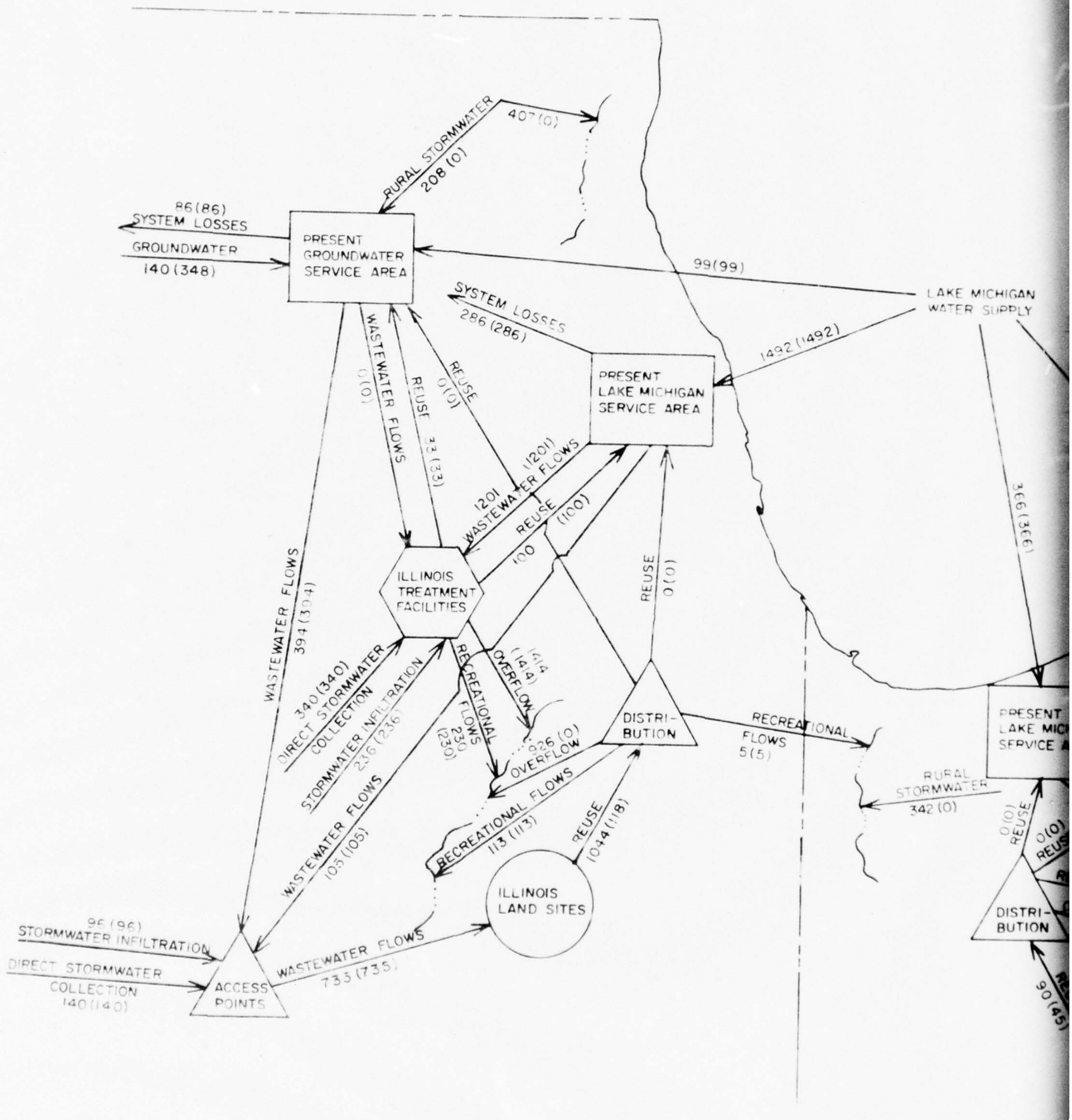


Figure D-V-B-4

WATER BALANCE
ALTERNATIVE IV
OPTION 2 - 1990 - SUMMER(WINTER)
NO RESTRICTION
ILLINOIS, LAKE MICHIGAN WITHDRAWAL



All Flows in MGD

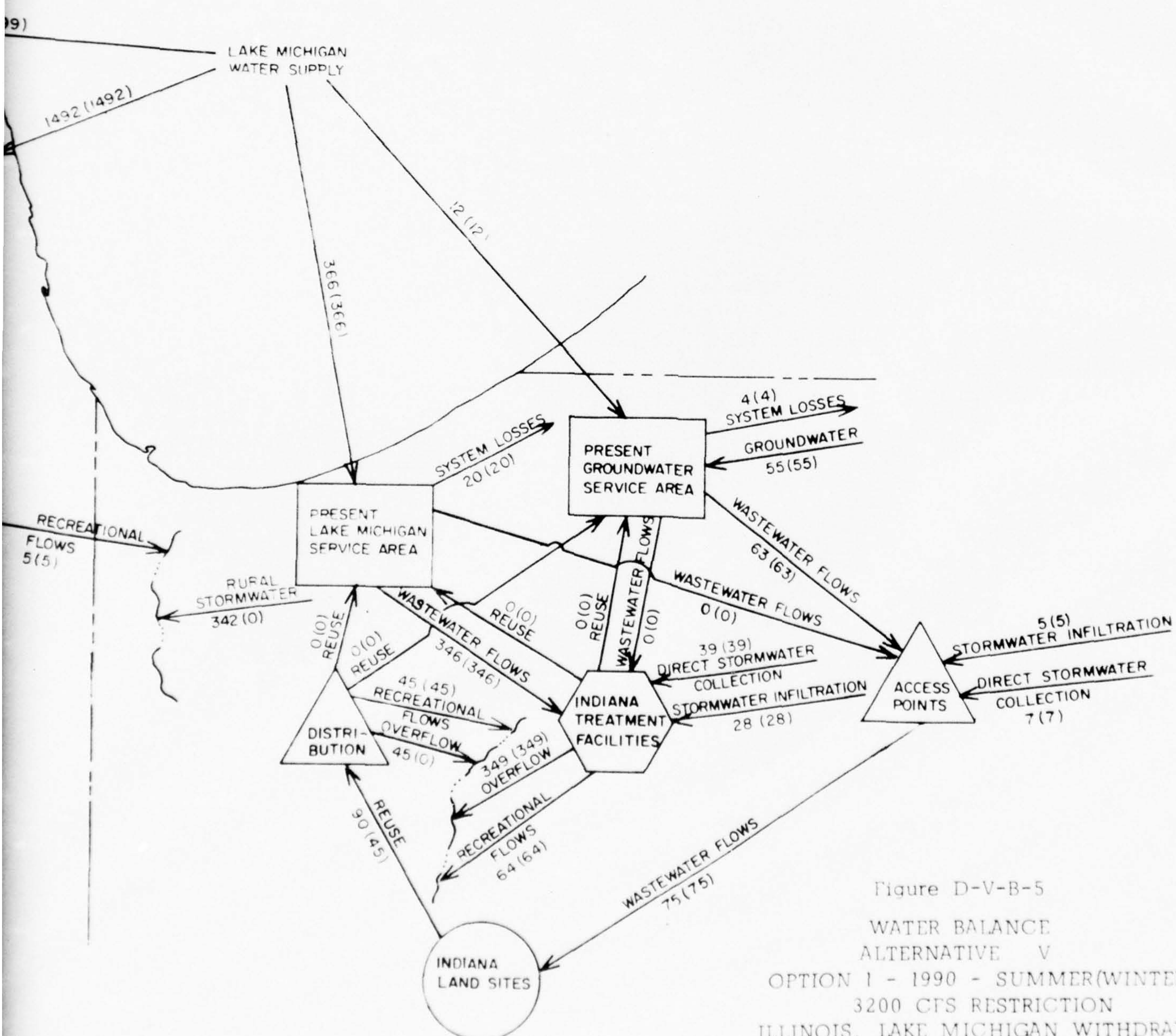
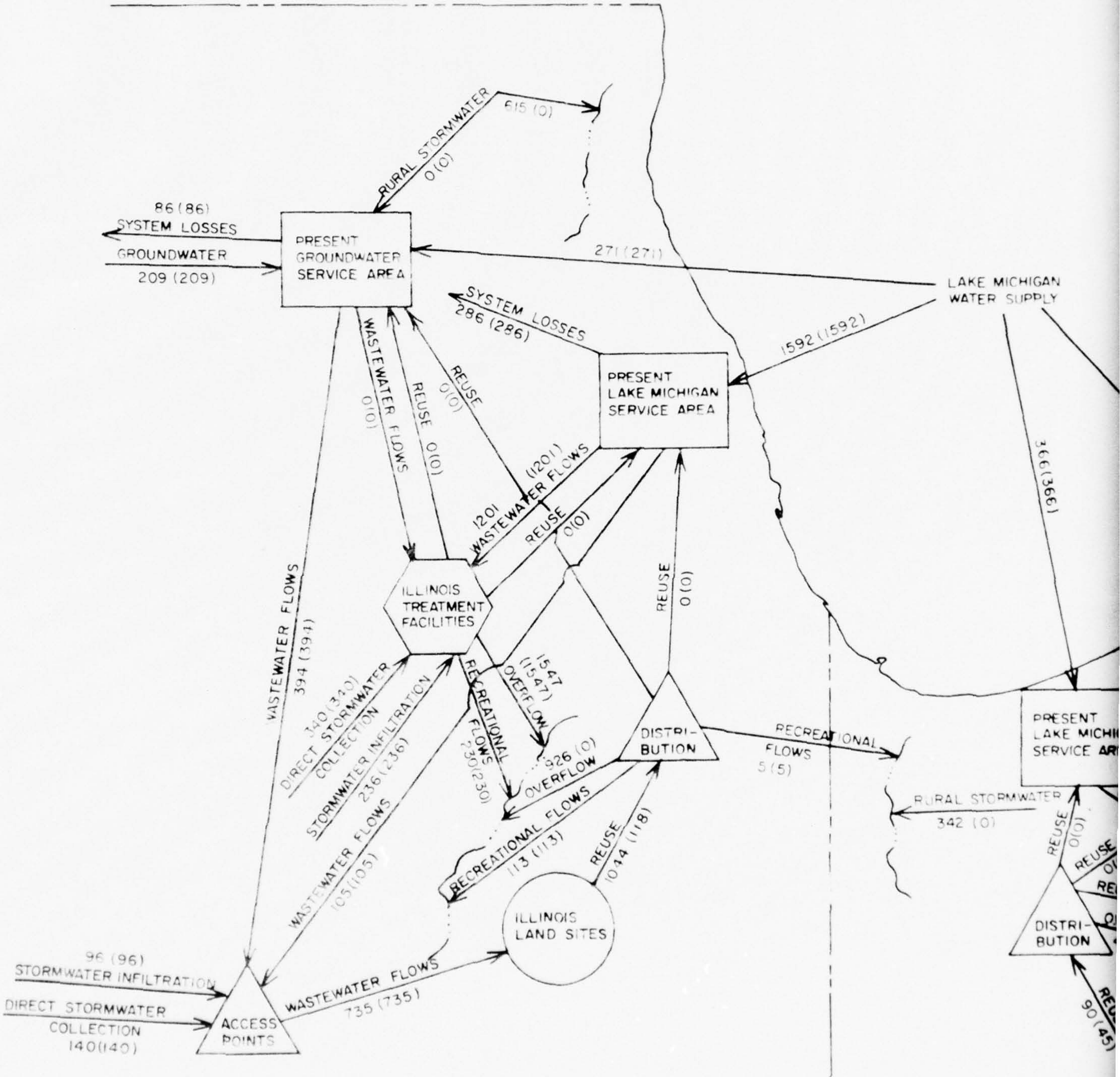


Figure D-V-B-5

WATER BALANCE
ALTERNATIVE V
OPTION 1 - 1990 - SUMMER(WINTER)
3200 CFS RESTRICTION
ILLINOIS, LAKE MICHIGAN WITHDRAWAL



All Flows in MGD

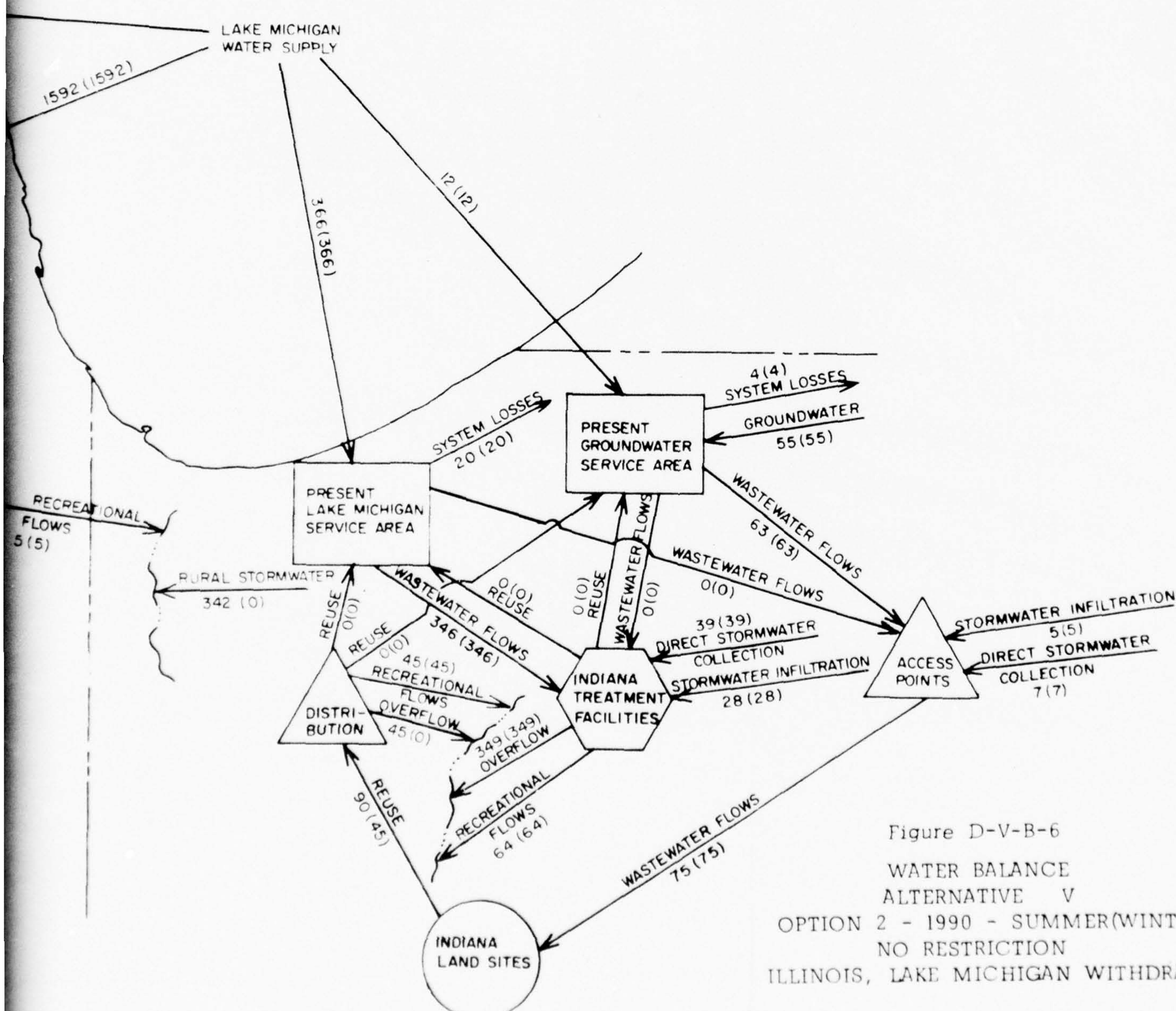


Figure D-V-B-6

WATER BALANCE
ALTERNATIVE V
OPTION 2 - 1990 - SUMMER(WINTER)
NO RESTRICTION
ILLINOIS, LAKE MICHIGAN WITHDRAWAL

The summer-winter variation in water supply flows is discussed in detail in the section on potable reuse found in Appendix B, Section IV-G.

Tables D-V-B-1 through D-V-B-6 present the eight water resource items for their comparably identified water balances.

STREAM FLOW QUANTITIES

A stream flow analysis related to Alternatives II-V is presented in Appendix D, Data Annex V-B. This stream flow analysis presents projected stream flow conditions for Illinois and Indiana waterways under the influence of the individual alternatives. These flows are then compared to the minimum and maximum stream flow conditions which are presented in Appendix B, Section IV-G.

Table D-V-B-1

WATER BALANCE TABLE

Alternatives II & III, Option 1

Water Resource Item	ILLINOIS Summer	ILLINOIS Winter	INDIANA Summer	INDIANA Winter
1. Supplies				
a. Lake Michigan	1,591	1,591	378	378
b. Groundwater	140	348	55	55
c. Rural Stormwater	208	0	0	0
d. M & I Reuse	133	133	0	0
2. M & I Supply System Losses	372	372	24	24
3. Untreated Wasterwater Flows	1,700	1,700	409	409
4. Direct Collection, Urban and Suburban Stormwater Flows	480	480	46	46
5. Infiltrated Urban & Suburban Stormwater Flows	232	232	33	33
6. Reuse Flows				
a. Recreational-Navigational	348	348	109	109
b. M & I	133	133	0	0
7. Treatment System Effluent Discharge	2,031	2,031	379	379
8. Rural Stormwater Flows	407	0	342	0

Table D-V-B-2

WATER BALANCE TABLE

Alternatives II & III, Option 2

Water Resource Item	ILLINOIS Summer	ILLINOIS Winter	INDIANA Summer	INDIANA Winter
1. Supplies				
a. Lake Michigan	1,863	1,863	373	373
b. Groundwater	209	209	55	55
c. Rural Stormwater	0	0	0	0
d. M & I Reuse	0	0	0	0
2. M & I Supply System Losses	372	372	24	24
3. Untreated Wastewater Flows	1,700	1,700	409	409
4. Direct Collection, Urban and Suburban Stormwater Flows	480	480	46	46
5. Infiltrated Urban & Suburban Stormwater Flows	232	232	33	33
6. Reuse Flows				
a. Recreational-Navigational	348	348	109	109
b. M & I	0	0	0	0
7. Treatment System Effluent Discharge	2,031	2,031	379	379
8. Rural Stormwater Flows	615	0	342	0

Table D-V-B-3

WATER BALANCE TABLE

Alternative IV, Option 1

Water Resource Item	ILLINOIS Summer	ILLINOIS Winter	INDIANA Summer	INDIANA Winter
1. Supplies				
a. Lake Michigan	1,524	1,724	378	378
b. Groundwater	140	348	55	55
c. Rural Stormwater	208	0	0	0
d. M & I Reuse	200	0	0	0
2. M & I Supply System Losses	372	372	24	24
3. Untreated Wasterwater Flows	2,512	2,512	488	488
4. Direct Collection, Urban and Suburban Stormwater Flows	480	480	46	46
5. Infiltrated Urban & Suburban Stormwater Flows	232	232	33	33
6. Reuse Flows				
a. Recreational-Navigational	348	348	109	109
b. M & I	3,566	659	540	129
7. Treatment System Effluent Discharge	3,018	311	431	20
8. Rural Stormwater Flows	407	0	342	0

Table D-V-B-4

WATER BALANCE TALBE

Alternative IV, Option 2

Water Resource Item	ILLINOIS Summer	ILLINOIS Winter	INDIANA Summer	INDIANA Winter
1. Supplies				
a. Lake Michigan	1,863	1,863	378	378
b. Groundwater	209	209	55	55
c. Rural Stormwater	0	0	0	0
d. M & I Reuse	0	0	0	0
2. M & I Supply System Losses	372	372	24	24
3. Untreated Wasterwater Flows	2,512	2,512	488	488
4. Direct Collection, Urban and Suburban Stormwater Flows	480	480	46	46
5. Infiltrated Urban & Suburban Stormwater Flows	232	232	33	33
6. Reuse Flows				
a. Recreational-Navigational	348	348	109	109
b. M & I	3,566	659	540	129
7. Treatment System Effluent Discharge	3,218	311	431	20
8. Rural Stormwater Flows	615	0	342	0

Table D-V-B-5

WATER BALANCE TABLE

Alternative V, Option 1

Water Resource Item	ILLINOIS Summer	ILLINOIS Winter	INDIANA Summer	INDIANA Winter
1. Supplies				
a. Lake Michigan	1,591	1,591	378	373
b. Groundwater	140	348	55	55
c. Rural Stormwater	208	0	0	0
d. M & I Reuse	133	133	0	0
2. M & I Supply System Losses	372	372	24	24
3. Untreated Wasterwater Flows	1,700	1,700	409	409
4. Direct Collection, Urban and Suburban Stormwater Flows	480	480	46	46
5. Infiltrated Urban & Suburban Stormwater Flows	232	232	33	33
6. Reuse Flows				
a. Recreational-Navigational	348	348	109	109
b. M & I	1,177	231	90	45
7. Treatment System Effluent Discharge	2,340	1,414	394	349
8. Rural Stormwater Flows	407	0	342	0

Table D-V-B-6

WATER BALANCE TABLE

Alternative IV, Option 2

Water Resource Item	ILLINOIS Summer	ILLINOIS Winter	INDIANA Summer	INDIANA Winter
1. Supplies				
a. Lake Michigan	1,863	1,863	378	378
b. Groundwater	209	209	55	55
c. Rural Stormwater	0	0	0	0
d. M & I Reuse	0	0	0	0
2. M & I Supply System Losses	372	372	24	24
3. Untreated Wasterwater Flows	1,700	1,700	409	409
4. Direct Collection, Urban and Suburban Stormwater Flows	480	480	46	46
5. Infiltrated Urban & Suburban Stormwater Flows	232	232	33	33
6. Reuse Flows				
a. Recreational-Navigational	348	348	109	109
b. M & I	1,044	118	90	45
7. Treatment System Effluent Discharge	2,473	1,547	394	349
8. Rural Stormwater Flows	615	0	342	0

TECHNICAL APPENDIX D

VI. COMPARISON WITH C-SELM MODEL STUDY

VI. COMPARISON: ALTERNATIVE IV - C-SELM MODEL STUDY

A. INTRODUCTION

This section outlines the design and cost differences between the dispersed land treatment system presented as Alternative IV, above and the land treatment system presented in the Technical Appendix to the Office of the Chief of Engineers report entitled, "Regional Wastewater Management Systems for the Chicago Metropolitan Area", March, 1972 (OCE-Model Study). Design and cost increases or decreases between the two alternatives emanate from two distinct sources: 1) technical refinements, and 2)changes in objective. The discussion of the impact of either the technical refinements or policy changes will be presented within a framework centering around the land treatment system first and then separable, ancillary regional management system components.

The land treatment system in this discussion is defined or limited to, the actual treatment function starting with the delivery of waste flows at the land site and terminating with the delivery of renovated flows to the reuse return conveyance tunnel. The separable items of the management systems include such ancillary components as conveyance systems, stormwater management systems, reuse systems, etc.

A discussion and comparison of the two alternative treatment technology systems, advanced biological and physical-chemical, will also be presented.

B. ALTERNATIVES COMPARISON

GENERAL

Land Treatment Systems

The major distinction to be made between the two land treatment alternatives is their location and siting characteristics. The OCE model study land treatment system was concentrated on a single site in North-Western Indiana, and North-Eastern Illinois, south of the Kankakee River. This site envisioned a very high land utilization of approximately 95 percent. The Alternative IV land treatment system is dispersed between five sites in Illinois and Indiana. In addition, to obtain minimum disruption of existing land-use, care was taken to locate treatment facilities within the current land-use. This decreased land utilization from 95 to approximately 40-50 percent.

This change in treatment site location and land utilization philosophy was prompted by the changes in objective and has obvious ramifications on the technical design. The discussion presented below will address the cost and design impact of this change in objective on the many components of the land treatment facility proper.

Ancillary Component Systems

It is evident that the change from a single site to a number of dispersed sites directly impacts items such as the conveyance systems which carry flows to the land sites and reuse return conveyance systems which carry flows back to the study area.

In addition, there have been other changes in the ancillary component systems which will be brought out later in the writing.

Method of Presentation

The following discussion of design changes will be finally presented as a change in cost per million gallons per day, i.e., $/MGD. The MGD referred to in this analysis is the average daily wastewater flow, including stormwater. It should also be pointed out that all costs in the original OCE-Model Study did not include contingencies or Engineering and Administrative fees. They have therefore been removed for this cost comparison. In addition,

the OCE Model Study was designed for an average daily flow of 2676 MGD while Alternatives for this Survey Scope report were sized for 3000 MGD average daily flow. This does not effect unit land system costs since the land system for both the OCE-Model Study and Alternative IV have achieved the same economy of scale. Cost differences will be reflected in the costs of ancillary system components and in the final, total land treatment system costs.

LAND TREATMENT SYSTEM

Capital

Each of the two land treatment systems, the OCE-Model Study and Alternative IV, are subdivided into ten system items for design and cost comparison. These ten items are:

1. Main Lift Pumping Station
2. Land Clearing and Site Preparation
3. Irrigation Systems
4. Drainage System
5. Aerated Lagoons
6. Storage Lagoons
7. Monitoring System
8. Electrical
9. Building and Grit Removal
   (Grit Removal not included in OCE)
10. Land and Relocation

A table of cost comparison for these ten items, for each land treatment scheme is presented in Table D-VI-B-1.

Main lift pumping station. The main lift, pumping station costs for Alternative IV decreased from the costs presented for the OCE-Model Study. An economic analysis was carried out which related pumping station capital and operation and maintenance costs associated with the lift from the conveyance tunnel to tunnel construction costs with different slopes, which produced different lift values. In the OCE-Model Study, minimum diameter tunnels with "higher" slope values were used to convey flows. Subsequently the lift at the land site was quite large with a resulting high capital pumping cost and a high operation and maintenance cost, particularly with respect to power consumption. In Alternative IV,

Table D-VI-B-1

SUMMARY COST COMPARISON

LAND TREATMENT SYSTEM Cost Item	OCE-MODEL STUDY COSTS $/MGD	ALTERNATIVE IV COSTS $/MGD
1. Main Lift Pumping Station	35,613	28,830
2. Land Clearing and Site Preparation	13,768	3,396
3. Irrigation System	65,172	202,286
4. Drainage System	83,724	154,500
5. Aerated Lagoons	27,838	40,378
6. Storage Lagoons	52,929	75,472
7. Monitoring Systems	1,611	1,887
8. Electrical	10,686	23,396
9. Buildings & Grit Removal[a]	1,332[a]	18,490[a]
10. Land & Relocation	119,904	48,645
Total	412,577	597,280

[a] Grit removal facilities not included in OCE-Model Study.

the diameter of the tunnel was increased and the slope was reduced compared to the Model Study, resulting in decreased pump station costs and operation and maintenance costs associated with the lesser lift. The cost of the tunnels was greater for Alternative IV than the C-SELM model study. This is discussed in the section on ancillary management system components. This was a technical refinement. The cost per MGD in Table D-VI-B-1 reflect this pump station cost reduction. The total savings are approximately $6800 per MGD.

There was also a technical refinement in pump station unit costs which increased the cost of an installed horsepower, but this refinement did not overcome the savings associated with the decreased lift of the station.

Land clearing and site preparation. Land clearing and site preparation costs decreased approximately 75% due to the new land site selection criteria described above. The installation of physical facilities does not require extensive tree or brush removal since items such as the spray irrigation rigs are placed primarily on existing cultivated land. The only major site clearing is projected for the lagoon areas, which encompass only about 25 percent of the net irrigation area. Reference is made to Table D-VI-B-1, item 2. The net cost differential is almost $10,000 per MGD. This cost change is directly associated with a change in objective of land utilization.

Irrigation system. Reference is made to item 3, Table D-VI-B-1. The irrigation system for Alternative IV is over three times as expensive as the system proposed in the OCE-Model Study. There are several reasons for this large increase, and each can be directly associated with the change in objective to a dispersed, low percentage land utilization system. A breakdown of Irrigation system components and their costs appears below:

Sub-item	OCE-Model Study Costs $/MGD	Alternative IV Costs $/MGD
A. Irrigation Pumping Station	8,812	16,604
B. Irrigation Machines	22,070	29,811
C. Irrigation Pressure Pipe	22,918	123,396
D. Irrigation Channels	11,372	0
E. Irrigation Tunnel Distribution	0	32,475
Total	65,172	202,286

The main cost increase effect came through higher pressure pipe costs (Sub-item C, above) associated with the center-pivot irrigation rigs which are now spread out over two to three times the previous area. The increased head associated with the greater conveyance distances also necessitated larger irrigation pumping stations and subsequent increased costs as seen in sub-item A, above. These two sub-items account for almost 80 percent of the irrigation system cost increases of $137,114/MGD.

Another cost increase can be seen in the center-pivot systems themselves (sub-item B, above). The change in objective to dispersed land required the use of some land areas with distinctly different soil characteristics than found at the OCE Model Study site. The soils in the new areas display less infiltration or intake capacity. In order to prevent surface runoff of spray irrigated flows, the application rate of irrigated flows had to be reduced to below the intake rate. To accomplish this, a modified center-pivot system was utilized which provides a much lower instantaneous application rate. This caused a 30 percent increase in the center-pivot system costs from $22,070/MGD to $29,811/MGD.

Another cost change in the irrigation system was affected by a change in the main wastewater distribution system. The OCE-Model Study utilized less expensive surface canals to convey the irrigation water from storage, while Alternative IV incorporates a tunneled distribution system. The reason for this change is the wide dispersion of the irrigation areas which does not lend itself to an open canal system. This created about a $20,000/MGD increase as shown in sub-items D and E, above.

Finally, the irrigation system has more operational flexibility. On the average it would operate at 75 percent capacity during the irrigation season for Alternative IV as opposed to the OCE-Model Study which was designed to operate at 84 percent.

Drainage system. The drainage system increase in costs associated with Alternative IV when compared is directly tied to the increase in land area. Item 4 of Table D-VI-B-1 shows that the drainage system costs have nearly doubled. The cost of the main drain piping system was decreased in Alternative IV by the extensive utilization of natural drainage channels where possible (sub-item C, above).

	Sub-Item	OCE-Model Study Costs $/MGD	Alternative IV Costs $/MGD
A.	Pumping Station&Force Mains	889	16,000
B.	Plastic Drainage Pipe	6,265	22,000
C.	Sewer Drain Pipe	65,198	59,000
D.	Drainage Channel	11,372	12,000
E.	Drainage Tunnel	0	45,500
	Total	83,724	154,500

The Alternative IV design incorporates areas which are not as well suited topographically for gravity drainage as the OCE-Model Study site. Because of this, drainage pump station and force main system increased for Alternative IV some $16,000/MGD. This change is directly related to the change in objective, and is shown in sub-item A, above.

The cost of the plastic drain tile system is over three times as expensive for Alternative IV (sub-item B, above). A number of factors are involved. First, the unit cost of the installed pipe was refined, based on recent contract awards. The spacing of the plastic drain pipe laterals was 500 feet, on centers, for the OCE-Model Study. The depth of the plastic pipe was on the average 8 feet. This spacing and depth were changed for Alternative IV.

The weekly irrigation was increased from an average of 3 inches per week in the OCE-Model Study to over 4.5 inches per week in Alternative IV. In fact there are a number of consecutive weeks in the growing season when the weekly application reaches the design capacity of 6 inches per week. This dictated an increase in the capacity of the drainage system in order to maintain the aerobic zone in the soil. In addition to the increased application, the drainage system was required to remove the infiltrated runoff from a 100 year rain fall, with the upper five feet of the soil staying in a saturated condition for no more than 48 hours. The reuse system, discussed later also impacts on the tile depth placement. In the land system, reuse flows must be provided from storage for the winter months, since the land system does not apply flows during that period. In the OCE-Model Study, reuse flows were stored in Lake Michigan. However, for Alternative IV, Lake Michigan storage was not available. (This non-availability is discussed in Appendix B, Section IV-6.) Therefore storage was created in the soil at a land site by increasing the depth of the plastic drainage piping, and storing

the water in this zone. These conditions, increased application, 100 year storm runoff requirement, and reuse storage brought about the reduction of the spacing between the tiles and increased the depth of the plastic drain pipe installation. Each of these changes were changes in objective.

The spacing between plastic drainage pipes in the areas which are common to the two land treatment systems (i.e., Indiana-Illinois, Kankakee River area) was reduced from 500 to 400 feet. In the new areas, with less permeable soils, the spacing was reduced to only 100 feet. To provide the necessary storage discussed above, the depth of the plastic drain pipe system was increased from 8 to 13 feet.

The final cost increase change is associated with the main drainage system which incorporates drainage tunnels which convey the total collected flow from a number of land treatment modules to a central drainage access point for transmission and reuse in the C-SELM area. The OCE-Model Study utilized surface channels, which were more economical, but because of the low land utilization objective this was not a viable consideration for Alternative IV. The overall increase is approximately $45,000/MGD as shown in item E, above.

Aerated Lagoons. Aerated lagoon costs for Alternative IV increased over those used in the OCE-Model Study. These increases are reflected below:

	Sub-Item	OCE-Model Study Costs $/MGD	Alternative IV Costs $/MGD
A.	Earthwork	5,878	7,170
B.	Slope & Roadway	1,769	4,906
C.	Aerators-Mixers	13,926	18,868
D.	Inlet-Outlet Structures	6,265	9,434
	Total	27,838	40,378

The new design, associated with the dispersed land treatment sites, utilizes smaller aerated cells of 55 acres of average water surface area, whereas the OCE-Model Study used 700 acre cells. This was a technical refinement directly associated to the change in objective decision of dispersed land treatment. The increased costs for actual lagoon construction are reflected in sub-item A, B, and D, above.

The cost of the aerators and mixers has also increased. A more expensive but more efficient and maintenance free low speed aerator was used for Alternative IV (sub-item C, above).

Storage lagoons. The cost of the storage lagoons for Alternative IV also increased over those of the OCE-Model Study. The cost breakdown for this item is as follows:

		OCE-Model Study Costs $/MGD	Alternative IV Costs $/MGD
A.	Earthwork	31,471	31,321
B.	Slope & Roadway	6,364	13,962
C.	Structures & Chlorination	15,094	30,189
	Total	52,929	75,472

The new storage lagoon cells were sized at 1200 acres each for Alternative IV compared with 5700 acres for the OCE-Model Study. The depth of storage was decreased from 25 feet to 20 feet since the storage requirement was reduced from five to four months. The earth work requirements cancelled one another between these two changes (sub-item A, above). However, the slope and roadway costs increased 100 percent due to the smaller modular design of the lagoons. This cost change was a technical refinement (in lagoon size) brought on by the change in objective to dispersed land treatment.

The cost of the flow structures, chlorination facilities, and drainage canals also increased greatly (100 percent) over the OCE-Model Study design, $15,094/MGD to $30,189/MGD. This was not only due to the smaller modular design but also the increased capacity and unit cost requirements for the chlorination facilities.

Monitoring systems. The monitoring system unit costs increased very slightly, reflecting the need for additional monitoring wells. This cost increase was brought about by the change in objective to a more dispersed land treatment system. Table D-VI-B-1 shows a change from $1,611/MGD to $1,887/MGD.

Electrical. The cost of the electrical system increased over 100 percent from the OCE-Model Study design. This cost increase reflects a refined cost estimation and the addition of more transmission costs associated with the more dispersed land system. The cost increase associated with electrical is approximately $13,000/MGD.

Buildings and grit removal. This buildings cost for Alternative IV is some 14 times as high as the OCE-Model Study ($1,332/MGD to $18,490/MGD). This is due to the inclusion of grit removal facilities prior to the aeration lagoons for Alternative IV. The OCE-Model Study did not have grit removal facilities.

Land and relocation. Alternative IV land and relocation costs decreased by approximately 60 percent from OCE-Model Study. The main reason for this decline in costs is that the only lands being purchased in Alternative IV are for the lagoon facilities. For the OCE-Model Study, all lands within the treatment site were purchased.

This cost reduction would be even greater except the unit land and relocation costs for the more dispersed system are some 75 percent greater than those used for the OCE-Model Study. This unit cost increase is due mainly to the use of the higher cost farm lands in McHenry, Kendall, and Kankakee Counties. In addition, the Alternative IV design calls for an initial lump sum payment equal to ten percent of the market value of the land to the farmer, plus the construction of a deep potable well.

Operation and maintenance costs. The operation and maintenance costs for the land treatment system are approximately the same as the OCE Study as shown below:

	O & M Costs $/MGD	
	OCE-Model Study	Alternative IV
Labor	15.35	27.00
Chemicals & Supplies	9.20	5.50
Energy	58.45	49.50
Total	$83/MG	$82/MG

The increased labor costs is the result of discussions with irrigation manufacturers with subsequent increases in manpower requirements. Also the smaller lagoon modules required greater unit labor costs. The chemical and supply unit cost decreases due mainly to the reduction of the chlorine dosage from 8 mg/l to 4 mg/l. The reduction in energy costs is mainly due to the decrease in static head at the main wastewater lift station. The new design

results in a savings of some \$15/MG. This however is offset by increased irrigation and drainage power requirements (\$7/MG).

Also associated with the new designs are annual land payments to the local farmers and rural governmental units. A cost of \$1/MG is assessed to the system in order to make up for the annual tax loss due to the purchase of lagoon facilities. An annual payment equal to 4% of the market value of the land is paid to the participating farmer since his land will be unavailable for other uses during the 50 year life of the system. This payment is equivalent to \$21/MG of treated wastewater.

Thus the total O & M cost of the new land treatment design = (\$82+1+21) or \$104/MG versus the \$83/MG OCE unit cost.

Replacement costs. The replacement cost for the new design is approximately \$87,000/MGD versus the \$20,000/MGD cost figure for the OCE Study. This is due to the increased capital costs of the various land treatment components together with revised estimates of the replacement schedule. Discussions with various manufacturers indicate that pumps and irrigation machines will require replacement every 10 and 15 years, respectively, rather than the initial design life estimate of 25 years.

Summary of land system costs. Total land treatment costs comparisons are as follows:

	OCE-Model Study Costs	Alternative IV Costs
Capital	\$412,577/MGD	\$597,000/MGD
Replacement	\$ 20,000/MGD	\$ 87,000/MGD
O & M	\$ 83/MG	\$ 104/MG

ANCILLARY COMPONENTS

General

The ancillary components under consideration for the purposes of this analysis are listed below:

1. Conveyance System
2. Stormwater Management System
3. Sludge Management System
4. Reuse System

Capital

The capital costs (w/o contingencies and E & A) for each of the ancillary system components are listed in Table D-VI-B-2 for the without stormwater condition. Prior to the analysis of ancillary system components, one principal difference between the two land treatment systems should be brought out. In the OCE-Model Study analysis, the without stormwater cost analysis reflected a system design which treated no stormwater other than infiltrated flows and those contributed by combined areas up to the hydraulic capacity of the combined system. The alternative IV without stormwater condition includes the management of stormwater flows through the implementation of the Chicago Underflow Plan and a management system for the remaining combined sewered area.

Conveyance system. The Alternative IV conveyance costs are more than double the companion costs associated with the OCE-Model Study. The conveyance system costs for Alternative IV, however, include all of the conveyance associated with the Chicago Underflow Plan. This cost has been projected as approximately $823.1 million. With this item removed, the conveyance cost for Alternative IV is approximately $755.7 million. This figure can be further reduced, too, by the reduction of the conveyance associated with the remaining combined areas. This reduction will make the two conveyance systems comparable between Alternative IV and the OCE-Model Study. The reduction is equal to $17.1 million, which yields a conveyance cost of $738.6 million.

The remaining cost for each of the two conveyance systems can be sub-divided into two parts as follows:

	OCE-Model Study	Alternative IV
	Costs $ Million	Costs $ Million
Conveyance to access points	69.1	95.6
Conveyance to land sites	558.6	643.0

The conveyance to access points reflects a cost increase due to the fact that in the OCE-Model Study the majority of this portion was gravity sewers while in Alternative IV the lines were regulated force mains. This was a technical refinement, and amounts to only about 23 percent of the total cost increase. The major difference can be seen in the increased cost for conveyance to land. This $84.4 million increase is directly due to the change in objective shift to the dispersed land system which entailed five conveyance tunnels to as many sites with subsequent loss of economies of scale.

Table D-VI-B-2

ANCILLARY COMPONENTS COST COMPARISON

	OCE-Model Study Costs $ Million	Alternative IV Costs $ Million
Conveyance System	627.7	1578.8
Stormwater Management System	0	763.1
Sludge Management System	23.3	82.4
Reuse System	279.0	799.3[a]
Total	930.0	3223.6

[a] includes recreational-navigational reuse only.

Stormwater management systems. The stormwater management component for the OCE-Model Study is equal to zero. In Alternative IV, the cost of $763.1 million is associated with the storage provided through the Chicago Underflow Plan ($400.1 million), the storage for other combined areas ($314.8 million), and conveyance regulation storage at access points ($48.2 million). The inclusion of these costs recognized the progress being made on the implementation of such programs by local agencies, and was a policy decision.

Sludge management systems. The sludge costs shown for Alternative IV have increased. A breakdown of system costs is as follows:

	Alternative IV $ Million	OCE-Model Study $ Million
Land Payments:	42.0[a]	0.0
Dredging:	1.6	1.6
Transportation:	8.6	6.5
Application:	30.0	15.2

The costs for land for the OCE-Model Study were included in the total land system costs and were not broken out separately. Therefore the true comparison of sludge management systems should be made on the Alternative IV cost, less land, or $40.2 million to $23.3 million. The major portion of this increase is seen in increased application costs. This cost increase reflects the change in objective with respect to the existing land-use and therefore produces a wider dispersion of available land for sludge application and produces a subsequent loss in economies of scale resulting in the increased application costs.

Reuse systems. The reuse system for the OCE-Model Study consisted of a pumping station and single conveyance tunnel which returned all flows to the Grand Calumet River divide. This cost was approximately $279.0 million. The reuse system associated with Alternative IV provides not only five return conveyance tunnels from the dispersed land sites, but also a complex pressure pipe system used to distribute over 500 MGD of flows to some 45 recreational injection points to provide esthetic recreation flows in C-SELM area streams. In addition closed cycle lockage costs are included. The direct injection of the recreational-navigational flows accounts for some $40.0 million. The remaining $759.3 million reflects the cost of returning the flows from the dispersed land site for the recreational-navigational reuse. This figure is still quite large when compared to the cost of flow return system for the OCE-Model Study.

The return tunnel was sized to convey the peak flow from the land system of some 9 inches, as compared with 6.75 for the OCE-Model Study. In addition, the return tunnel for the OCE-Model Study was some 26 miles in total length. The return tunnels for Alternative

[a] For the sludge management system, land is not purchased but leased.

IV, associated with the complex return needs to area streams where they could be discharged, amounted to some 302 miles, or over ten times as much. Also, there were over 600,000 feet of pressure pipe in the reuse conveyance system. The cost for this tunnel-force main system amounted to some $606 million of the $759.3, with the remaining $153.3 million associated with pump station costs. The pump-station costs associated with the OCE-Model Study were some $22 million.

It can be seen that the return conveyance costs almost tripled for the tunnel-pipeline system, and more than quintupled for the pump-station costs. These increased costs are tied directly to the policy decision associated with the dispersed land system concept and the creation of the extensive reuse program envisioned for the returned, reclaimed wastewater flows.

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WASTEWATER MANAGEMENT STUDY FOR CHICAGO-SOUTH END OF LAKE MICHI--ETC(U)
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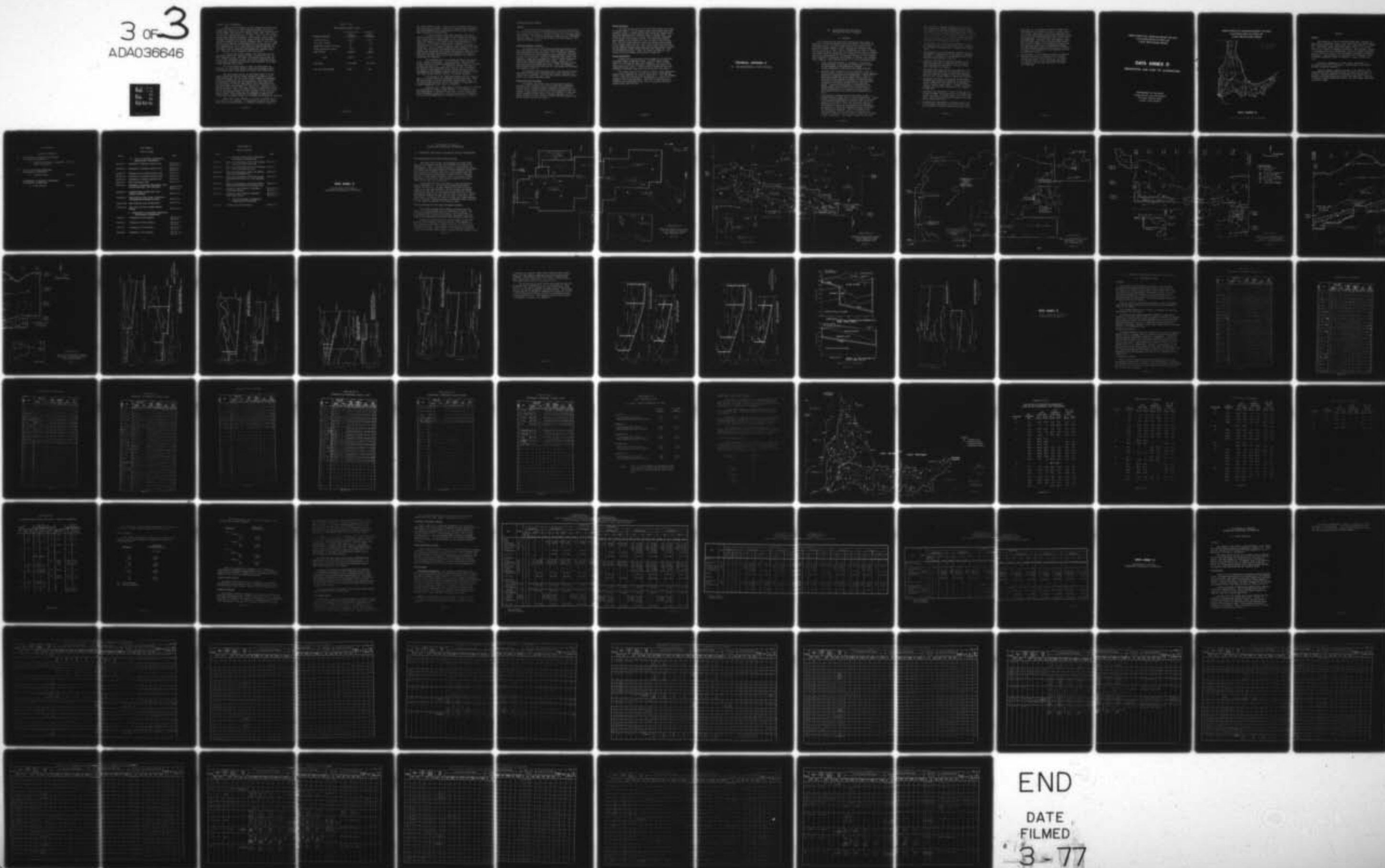

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CAPITAL COST COMPARISON

Table D-VI-B-3 presents the total management system costs for both alternatives on a without stormwater basis. The $1,070 million figure reflects the land treatment system cost associated with reduced flows. This results in a slightly higher dollar cost to treat one MGD as compared with the unit costs shown in the treatment system costs including stormwater. The treatment system costs for Alternative IV reflect the unit cost figures for the with stormwater analysis multiplied by the without stormwater flows. This is a valid analysis since there are compensating factors in the unit cost, with some driving-up of the unit cost because of increased storage for the increased flows, etc., and others which tend to drive the unit cost down, such as decreased land requirements, irrigation rigs, etc. These two factors basically cancel one another.

It can be seen that the capital costs associated with the conveyance system have increased. This is discussed in the section immediately above. The costs for stormwater management are zero for both management systems. The sludge management system in Alternative IV reflects the increased costs discussed in the above section describing this system.

The reuse system costs are shown as $300 million for Alternative IV. This figure reflects a least cost estimate to return the reclaimed flows to the nearest river within the C-SELM area.

The total system cost for the OCE-Model Study of $2,000 million reflects the cost for without stormwater presented in the Model Study report. The sum of the without stormwater management system for Alternative IV is $2,556.4 million. When these figures are normalized to reflect the two different flow bases which they treat the figures are $0.842 million/MGD and $1.032/MGD for the OCE-Model Study and Alternative IV, respectively, reflecting a 22.6 percent increase in cost. The major increase is associated with the treatment function, including the actual treatment facility, the conveyance to the treatment facility and the management of the treatment system sludges. This increase can be examined to determine the amount due to technical changes as contrasted with changes in objectives.

Before this is done, however, it is proper to remove the reuse system from the analysis. In conventional treatment, the effluent flow from this treatment facility is allowed to discharge directly to

Table D-VI-B-3

MANAGEMENT SYSTEM COSTS

System Component	OCE-Model Study Costs $ Million	Alternative IV Costs $ Million
Treatment System	1,070.0	1,477.6
Conveyance System	627.7	738.6
Stormwater Management System	0	0
Sludge Management System	23.3	40.2
Reuse System	279.0	300.0
Total	2,000.0	2,556.4
Flow Basis	2376 MGD	2474 MGD
Unit Cost $ MIL /MGD)	0.842	1.032

the usually adjacent stream. This is also an available option for the land treatment system. There are a number of available streams and rivers adjacent to or running through the land sites, capable of easily removing the effluent flows.

A careful analysis of the three remaining cost figures, after the deletion of reuse on Table D-VI-B-3 shows that the treatment facility costs are approximately 62 to 66 percent of the total costs, conveyance is 33-37 percent and sludge management 1.5 to 2 percent. The treatment facility proper is therefore the most important feature on the cost comparison, with the conveyance system second. The two systems compose over 98 percent of the total system cost for both the OCE-Model Study and Alternative IV. In addition, the percentage cost increase attributable to these two systems makes up about 96.6 percent of the total $535.4 million increase for the entire system, less reuse (treatment 78.3 percent, conveyance 18.3 percent).

The important point to be brought out here is the impact of the changes in objective on this increase. The treatment facility increase was affected tremendously by the changes in objective, to dispersed land sites. An analysis of the unit cost data on the treatment system presented above indicate that an estimated 95 percent of the increase in the unit cost values can be tied to the dispersed land treatment concept, and the low utilization of the land areas through selective location of treatment facilities.

The increase in the conveyance system costs can also be tied to the policy change for dispersed land treatment sites. This has been brought out in the conveyance system section above. It is estimated that 90 percent of the cost increase in conveyance is directly attributable to the change in objective.

Therefore, the overall effect of the two changes in objective on the increase in costs is quite sizeable. It is possible to say that approximately 91 percent (78.3% x 95% + 18.3% x 90%) of the entire management system cost increase (less reuse) of Alternative IV over the OCE-Model Study is caused by the changes in objective.

TREATMENT PLANT SYSTEMS

General

For the treatment plant system costs of the OCE-Model Study, the cost changes reflected in Alternatives II and III relate to the treatment systems themselves, the storage facilities and the sludge management systems. The following discussion utilizes the with stormwater treatment analysis. The cost trends remain the same, however, for a without stormwater analysis.

Advanced Biological Treatment

The capital cost for the advanced biological treatment facilities were equal to some 1.4 million dollars per MGD of average daily flow treated for the OCE study. For a comparable cost basis, the unit capital cost for advanced biological treatment in Appendix D is 96.8% of OCE cost. Technical refinements were made in the Appendix D costs which increased the costs of certain components, namely the nitrification-denitrification system. These costs increased were negated through the use of storage facilities at treatment plants which modulated peak flows. Thus, the treatment plant capacities were decreased from the OCE design which effected cost savings of some 3%.

The operation and maintenance costs of the advanced biological system for Appendix D has decreased in costs from the OCE study by 8% to $219/MG. This was due mainly to technical refinements in the carbon adsorption system.

Physical-Chemical Treatment

The present unit capital costs for the physical-chemical treatment facilities reflect a 10% cost savings when compared to the OCE study. Although technical refinements concerning post aeration and grit removal facilities increased component costs, the decrease in total system costs is due to the decrease in peak capacities resulting from the design of storage facilities. For the physical-chemical system, the unit operation and maintenance costs did not change from the OCE study.

Storage Facilities

The total capital cost for the OCE storage system was some 1.3 billion dollars. For the present study, the storage costs were reduced to some 1.0 billion dollars even though new storage facilities were designed at the treatment plants to regulate flow. The reason for this decrease in cost was due to technical refinements in the design of the storage systems. The OCE study utilized deep quarried pit excavations at a cost of some $7,000 per acre-foot. The new design utilizes shallow pit storage where feasible in the C-SELM study area at a cost of some $2,000 per acre-foot. For the highly developed urban areas where surface storage facilities are not feasible, mined storage facilities were utilized at a cost of $28,000 per acre-foot. Thus, the overall net effect is a decrease in the OCE storage facility cost by some 20%.

Sludge Management

Although the land payments have increased for the advanced biological sludge management system, the total system capital costs have remained the same when compared to the OCE study. This is due to technical refinements concerning the design of the sludge application system. These technical refinements have also resulted in decreased O&M costs from the previous OCE design.

The capital costs for the physical-chemical sludge management system have increased from the OCE study figure of $55,000 per MGD to some $300,000 per MGD for Appendix D. This cost increase is due to technical refinements in detailing the composition and quantity of the sludge generated. The result of this analysis is increased land requirements which result in increased application system costs and O&M costs.

TECHNICAL APPENDIX D

VII. RECOMMENDATIONS & PILOT PROGRAMS

VII. RECOMMENDATIONS FOR FUTURE STUDIES AND PILOT PROGRAMS

A. GENERAL

The C-SELM Regional Wastewater Management study covers a broad array of regional planning concerns as well as engineering and technology issues. Not all of these concerns and issues can be given the complete attention that the planners and engineers might wish in the course of such a study. Furthermore, by reason of being a survey-scope study, there must exist further detailed work in selected areas which would be required prior to proceeding to plans and specifications for implementation of any particular alternative. The following list of additional recommended work attempts to identify those selected topics requiring a more detailed analysis or a more concentrated effort.

1. Public information program of a minimum of one year in duration devoted to educating the affected people towards an understanding of the alternatives available for the management of their water and related resources.

2. Treatment plant prototypes would be desirable in order to optimize design concepts for implementation of either advanced biological or physical-chemical technologies. These prototypes should preferably be associated with a module of treatment capacity installed in Indiana C-SELM and should be capable of returning reclaimed water to Lake Michigan, according to the priority concerns for Lake Michigan quality. Among the characteristics of performance that should undergo scrutiny would be the responsiveness of treatment efficiency to flow regulation and the removal and ultimate disposition of nitrogen from reclaimed M & I flows.

3. Land treatment prototypes would be desirable in order to optimize design concepts prior to major implementation. These prototypes should preferably be associated with a land site in the Indiana Kankakee River area and a land site in the McHenry County area. Those two land areas represent the extremes in soil types, permeabilities and topographies encountered in C-SELM land treatment systems and should be independently evaluated. The most expedient prototype development could be achieved by developing the prototypes around local service areas in Indiana and McHenry County, respectively. Any number of towns in these two

areas could be considered suitable for this prototype role. Rensselaer, Indiana, and Marengo, Illinois, would be examples of towns with existing collection systems that adjoin nearby appropriate agricultural lands. Specific areas of scrutiny in a land treatment prototype would include the nature of the agricultural management system and the homogeneity of the soils insofar as infiltration capacity and permeability are concerned.

4. Implementation of a land treatment alternative should be integrated with an ancillary design plan for serving the wastewater treatment needs of nearby rural communities.

5. Implementation of a land treatment alternative must be preceded by a detailed soil boring program to determine the degree of variability or homogeneity present in the hydraulic characteristics of the soil.

6. Undertake hydrologic and hydraulic analyses of the affected watercourses to determine the flood plain relief that might be expected as a result of stormwater interception and storage.

7. Investigate the surface runoff versus infiltration characteristics associated with outer suburban and rural land use under the influence of SCS soil management practices and examine effects on watercourse baseflow.

8. Investigate the degree of opportunity for groundwater recharge with simultaneous treatment via recharge pits in the C-SELM area and evaluate as an alternative source of potable water supply. A number of potential recharge areas have been identified in the suburban C-SELM area.

9. Investigate the opportunity to obtain navigational recreational benefits with reduced flows in C-SELM watercourses by means of a large number of on-stream riffle dams. This would permit deeper in-stream pools with reduced watercourse flows.

10. Investigate the opportunity for distributing reuse flow to the C-SELM watercourses via on-site, open space land treatment for selected suburban stormwater areas.

11. Investigate the long range necessity for dealing with Great Lakes level regulation in order to control erosion and include consideration of returning reclaimed M & I flows to the Great Lakes including Lake Michigan during the drought part of the hydrologic cycle to aid in this accomplishment. Ancillary to this investigation, determine the exact nature of the dissolved solids content and the rate of change of this content associated with Lake Michigan based upon a representative breadth and depth sampling program and determine the direction of migration of the dissolved solids resulting from the principle point sources.

12. Implementation of any C-SELM wastewater management alternative should be accompanied by an extended mapping and design of the C-SELM area to include the upstream portion of the Des Plaines watershed in Wisconsin and any other watersheds that extend into Wisconsin.

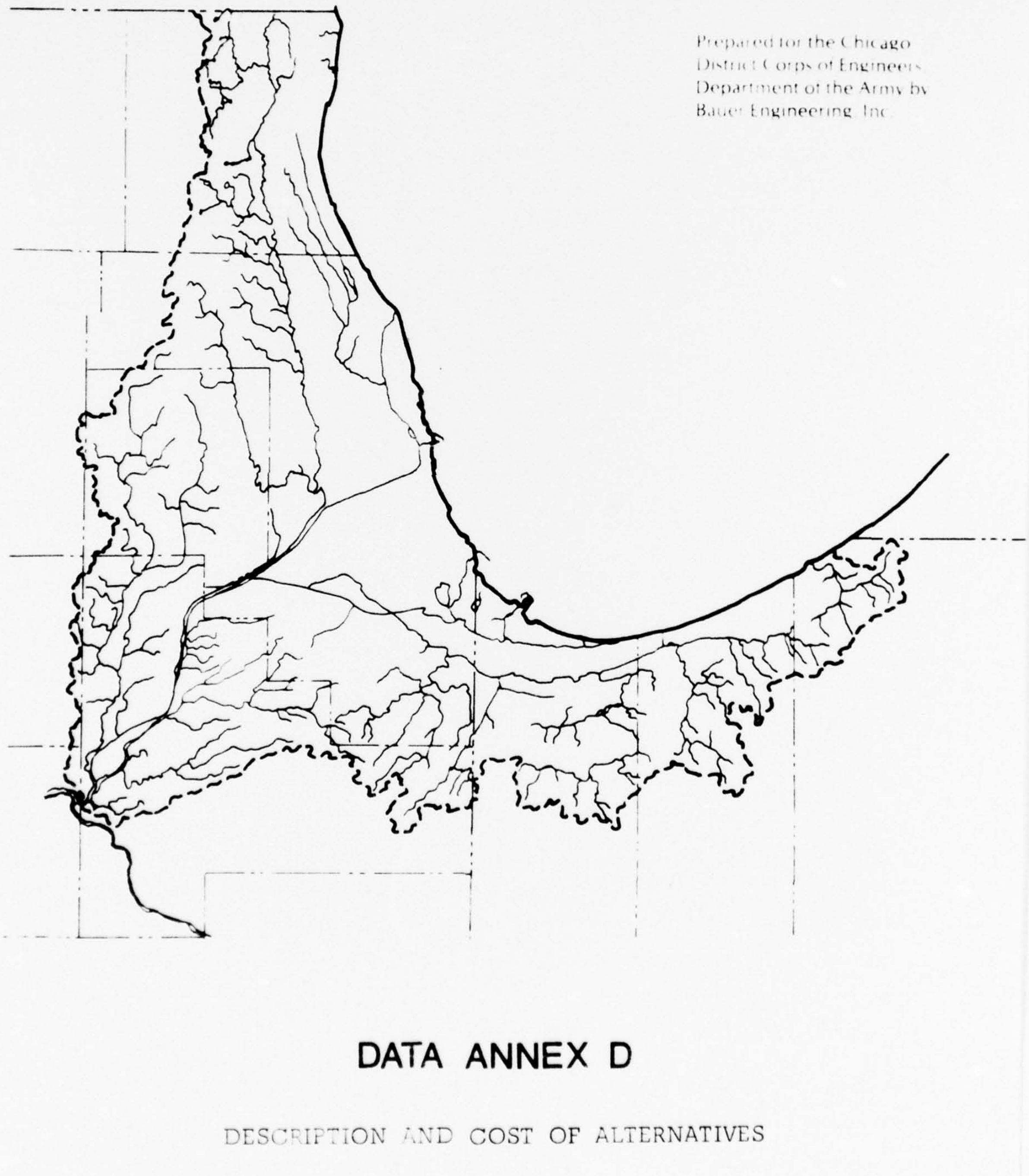
WASTEWATER MANAGEMENT STUDY
CHICAGO-SOUTH END OF
LAKE MICHIGAN AREA

DATA ANNEX D

DESCRIPTION AND COST OF ALTERNATIVES

DEPARTMENT OF THE ARMY
Chicago District, Corps Of Engineers
219 South Dearborn Street
Chicago, Illinois 60604

WASTEWATER MANAGEMENT STUDY
CHICAGO-SOUTH END OF LAKE MICHIGAN AREA



Prepared for the Chicago District Corps of Engineers Department of the Army by Bauer Engineering, Inc.

DATA ANNEX D

DESCRIPTION AND COST OF ALTERNATIVES

PREFACE

GENERAL

This volume is a part of the United States Army, Chicago District, Corps of Engineers, Survey Scope Study Report for Regional Wastewater Management in the Chicago-South End of Lake Michigan (C-SELM) area. The overall Survey Scope Study Report consists of a summary volume and a number of supporting appendices. This appendix, Appendix D, Description and Cost of Alternatives, contains a detailed description and cost analysis for each of the five regional wastewater management alternatives. Each alternative is constructed from management system components described in detail in Appendix B, Basis of Design and Cost.

Included in Appendix D is a data annex, Data Annex D - Description and Costs of Alternatives, which presents more detailed, pertinent supporting information.

The Data Annex is structured parallel to the Appendix, with corresponding roman-numeraled sections and upper case, lettered subsections. Specific information is referenced in the Appendix and is placed in the parallel Data Annex Section and Subsection. There are a number of section subsections which do not have material referenced in the Data Annex.

DATA ANNEX D

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II. DESCRIPTION OF REGIONAL WASTEWATER MANAGEMENT ALTERNATIVES

II. DESCRIPTION OF REGIONAL WASTEWATER MANAGEMENT ALTERNATIVES

C. ALTERNATIVE WASTEWATER MANAGEMENT SYSTEM DESCRIPTIONS

SOIL ASSOCIATIONS FOR LAND TREATMENT SITES

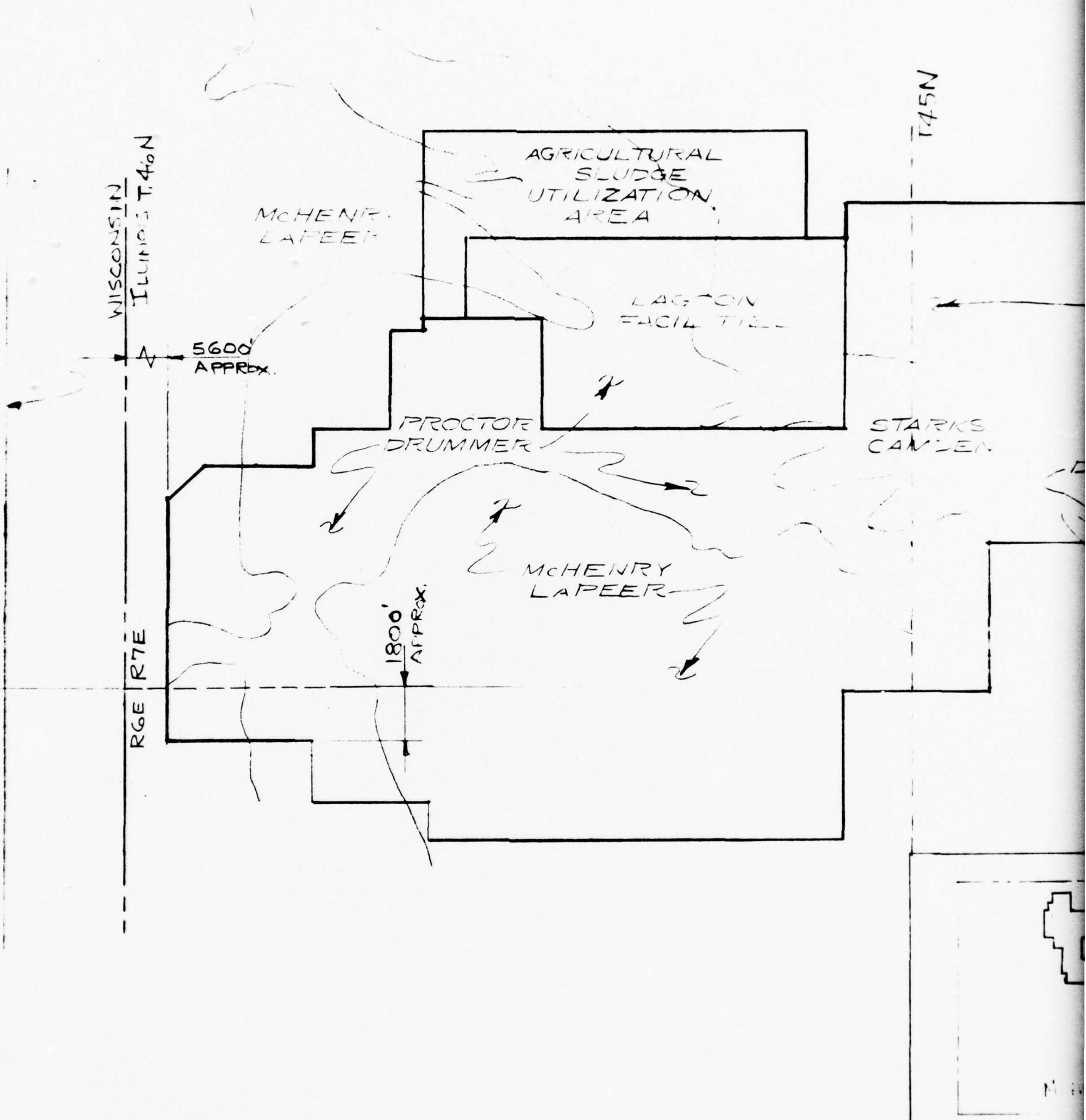
Presented in this section are generalized soil maps which were used to determine feasible land treatment site locations for Alternative IV. These soil maps enable one to define general soil characteristics which are important parameters concerning the engineering, design and subsequent operation of a land treatment system. The major soil associations for the five land treatment sites comprising Alternative IV are presented in Figures DA-II-C-1 through DA-II-C-5. These figures should be used in conjunction with the Data Annex B, Section IV-A which presents pertinent soils information for the major soil associations.

Two general soil types are reflected in the land treatment sites of Alternative IV. For the Newton-Jasper-Pulaski-Starke Counties site the soils are quite permeable (400 gpd/ft^2) and are composed of sandy type materials. For the McHenry and Kendall County sites, the soils are less permeable (100 gpd/ft^2) and are classified as sandy loams, silt loams or sandy clay loams. Grundy-Will-Kankakee-Iroquois Counties site has areas of both soils mentioned above. In general, the lagoon facilities and sludge utilization areas are located on slowly permeable or impermeable type soils such as clays which are adjacent to the irrigation areas.

TUNNEL PROFILES FOR THE LAND TREATMENT SYSTEMS

This section presents tunnel profiles associated with the design of the land treatment sites for Alternatives IV and V. The geological information which was utilized in the development of these profiles was obtained from information presented in the OCE-C-SELM Model Study and from Illinois State Geological Survey data.

Presented in Figure DA-II-C-6 are the profiles for the land treatment site wastewater conveyance tunnels. The alignment of these tunnels are presented in Figures D-II-C-8 and D-II-C-11 for Alternatives IV and V. These profiles were used in a cost analysis to determine the least costly design of a land treatment conveyance system. The results of this analysis indicates that the tunnels should



AGRICULTURAL SLUDGE UTILIZATION AREA
McHENRY LAPEER
WISCONSIN
ILLINOIS T.46N
T45N
5600' APPROX.
LAGOON FACILITIES
PROCTOR DRUMMER
STARKS CAMDEN
McHENRY LAPEER
1800' APPROX.
R7E
R6E

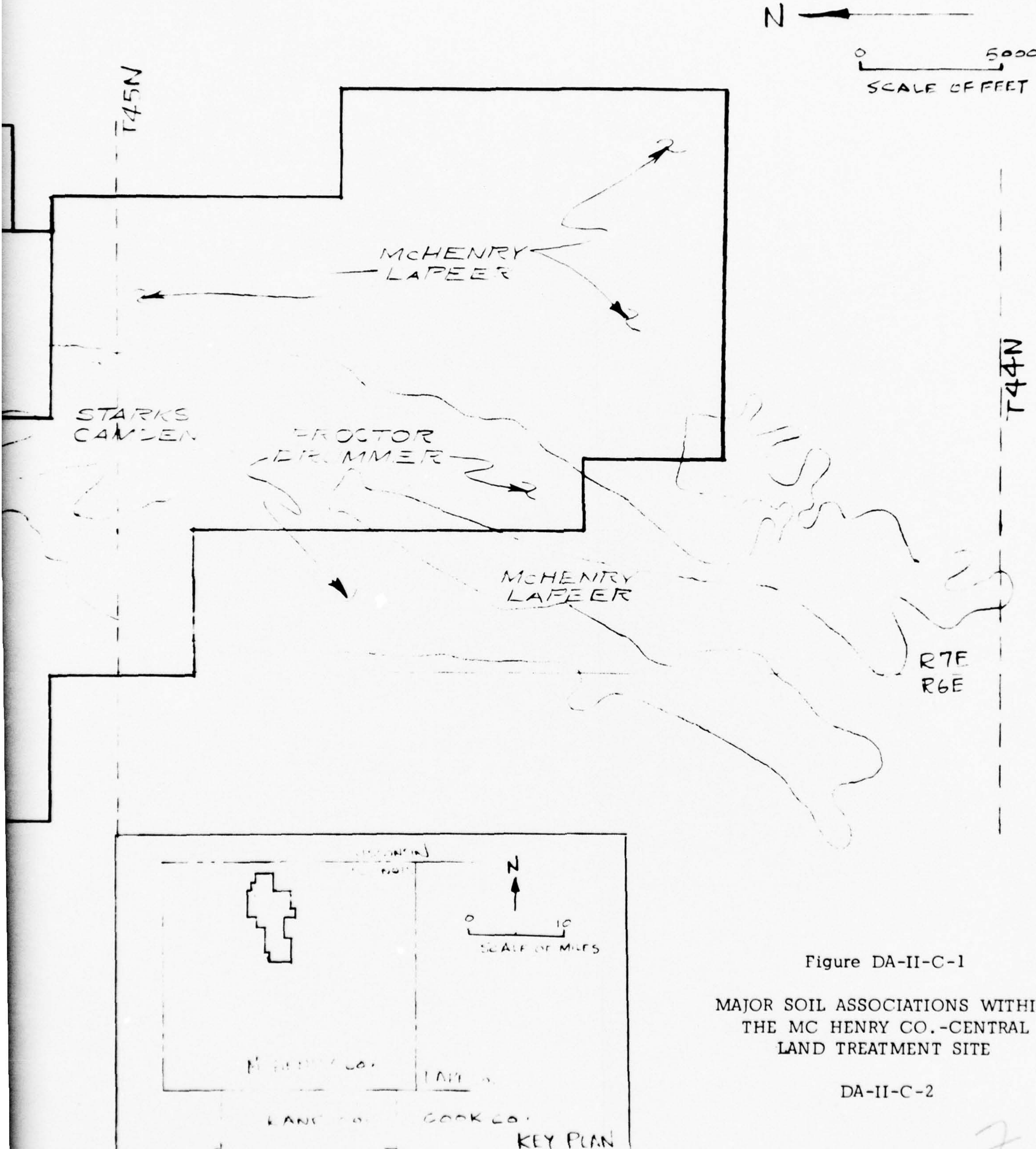
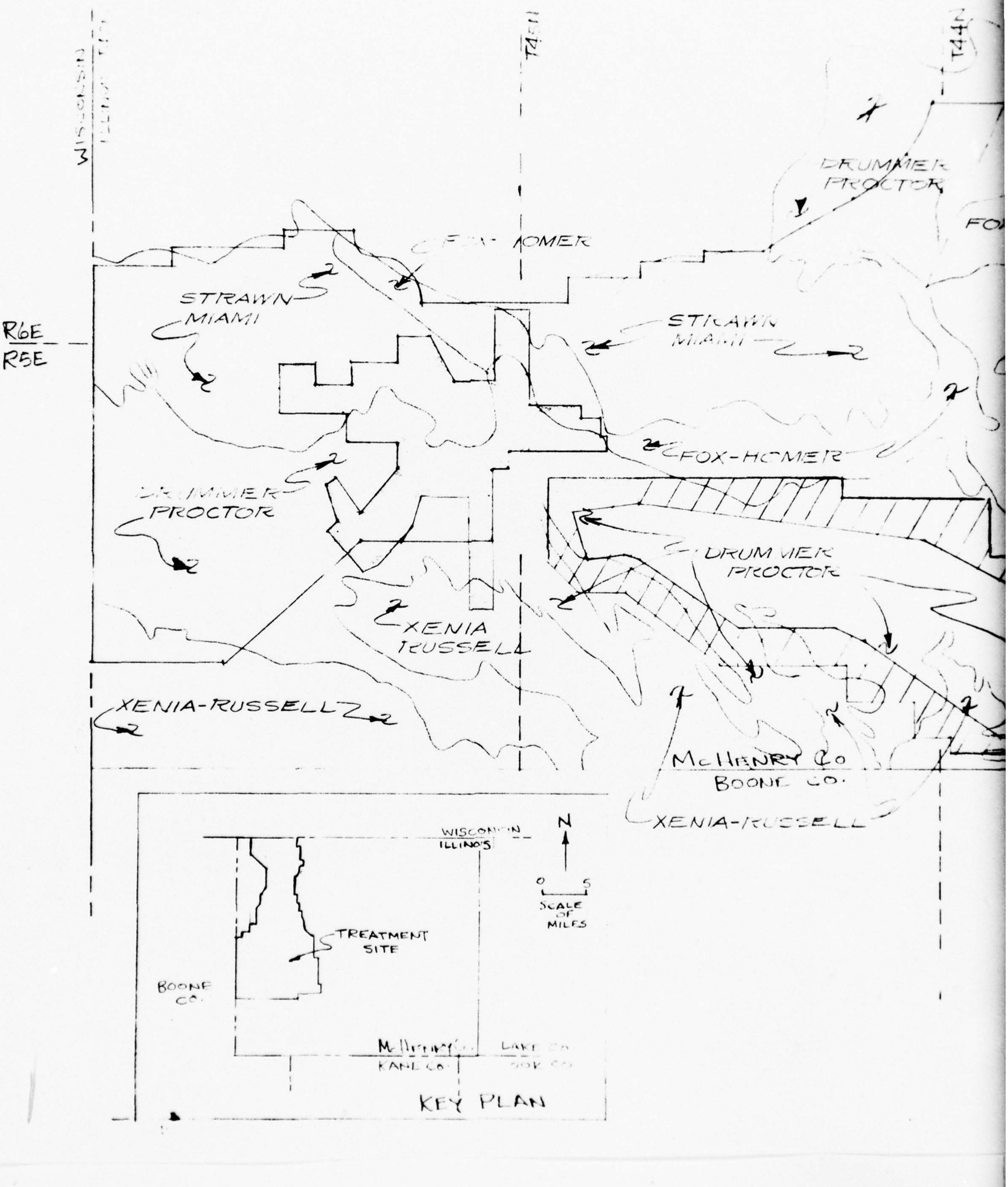


Figure DA-II-C-1

MAJOR SOIL ASSOCIATIONS WITHIN THE MC HENRY CO.-CENTRAL LAND TREATMENT SITE



WISCONSIN
ILLINOIS
T45N
T44N
R6E
R5E
DRUMMER
PROCTOR
FOX-HOMER
STRAWN
MIAMI
STRAWN
MIAMI
FOX-HOMER
DRUMMER
PROCTOR
DRUMMER
PROCTOR
XENIA
RUSSELL
XENIA-RUSSELL
McHENRY Co
BOONE CO.
XENIA-RUSSELL
WISCONSIN
ILLINOIS
N
0 5
SCALE OF MILES
TREATMENT SITE
BOONE CO.
McHENRY Co.
KANE Co.
LAKE CO
COOK CO
KEY PLAN

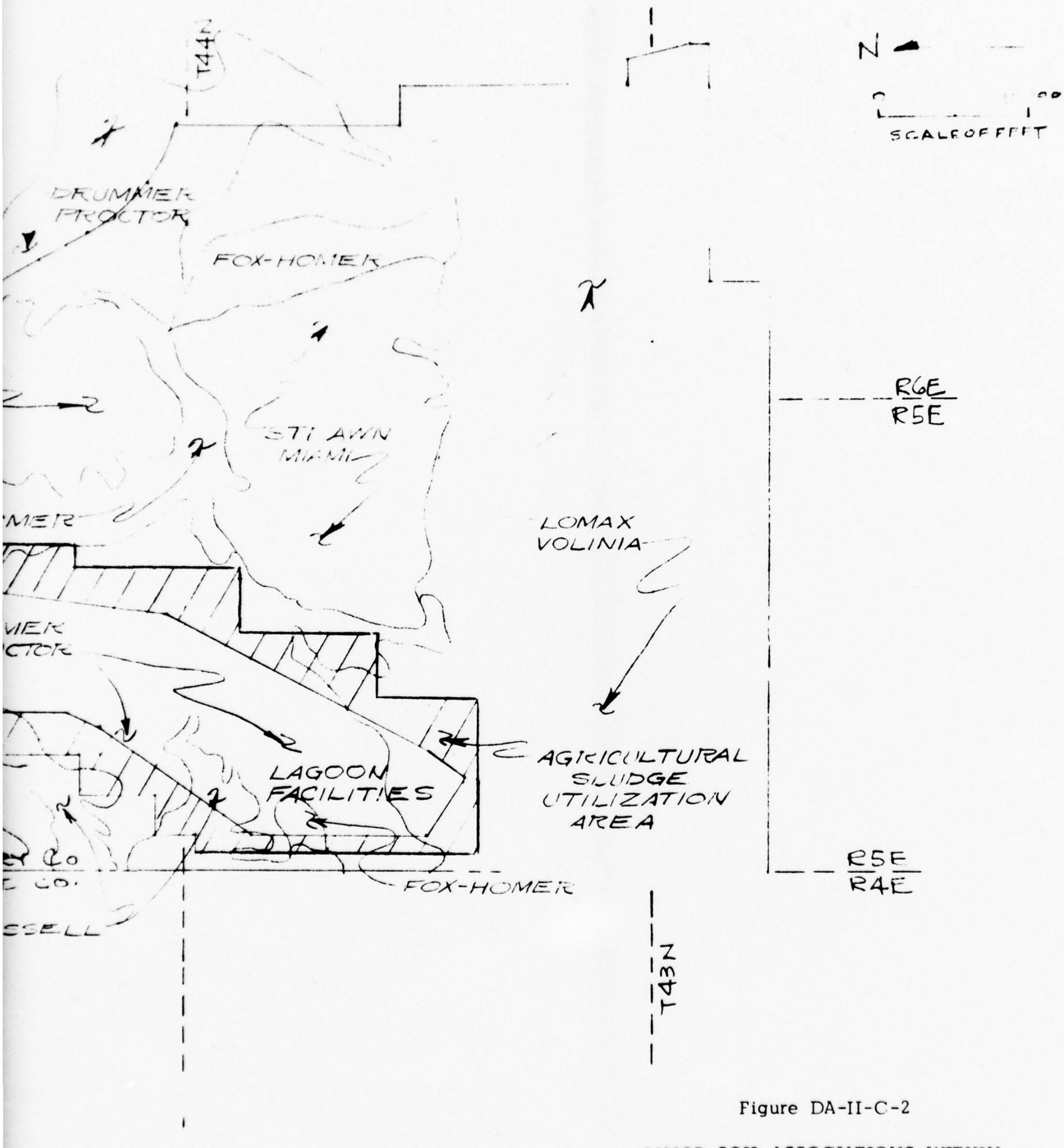
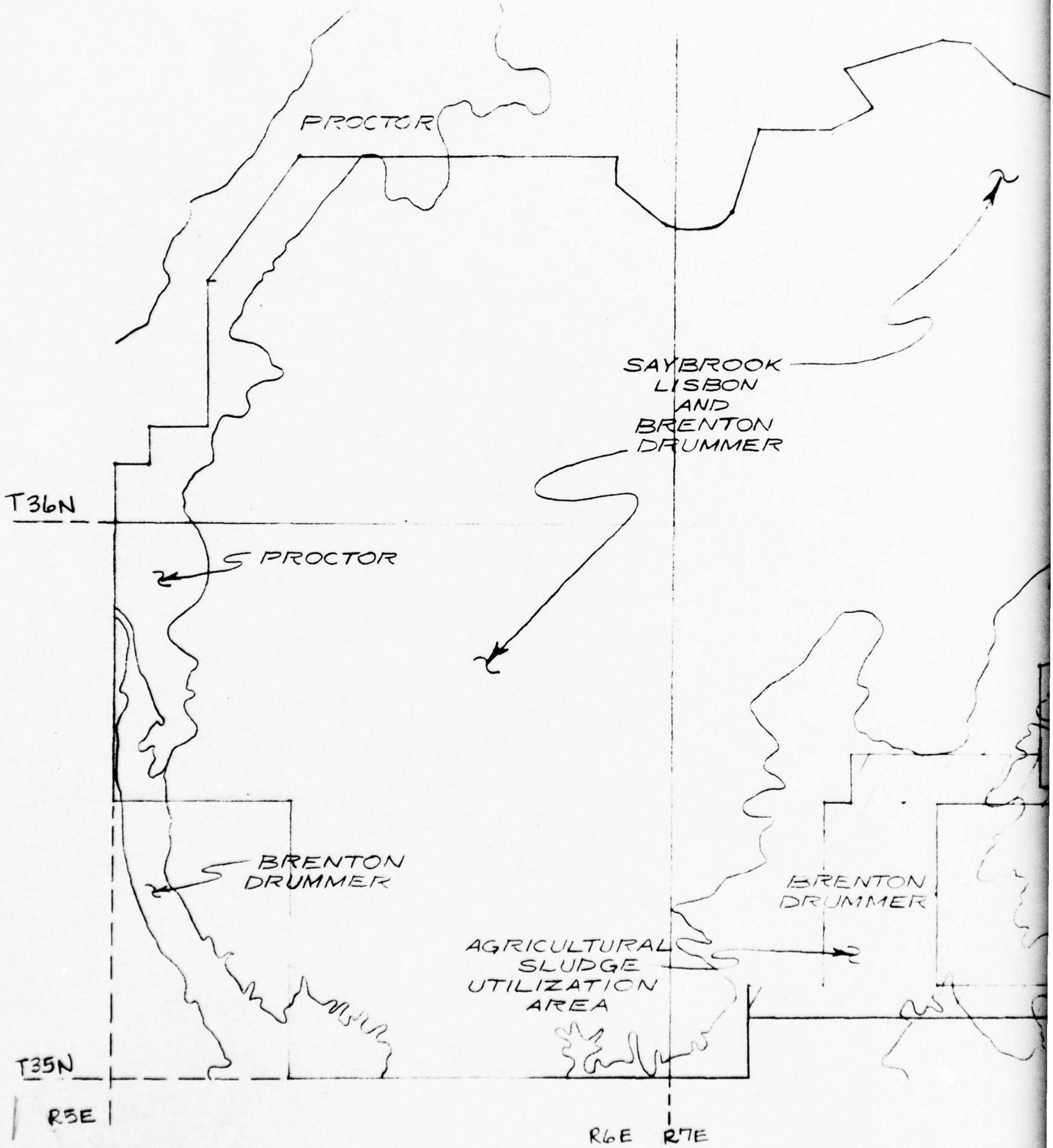


Figure DA-II-C-2

MAJOR SOIL ASSOCIATIONS WITHIN
THE MC HENRY CO.-WEST
LAND TREATMENT SITE


PROCTOR
SAYBROOK
LISBON
AND
BRENTON
DRUMMER
T36N
PROCTOR
BRENTON
DRUMMER
BRENTON
DRUMMER
AGRICULTURAL
SLUDGE
UTILIZATION
AREA
T35N
R5E
R6E
R7E

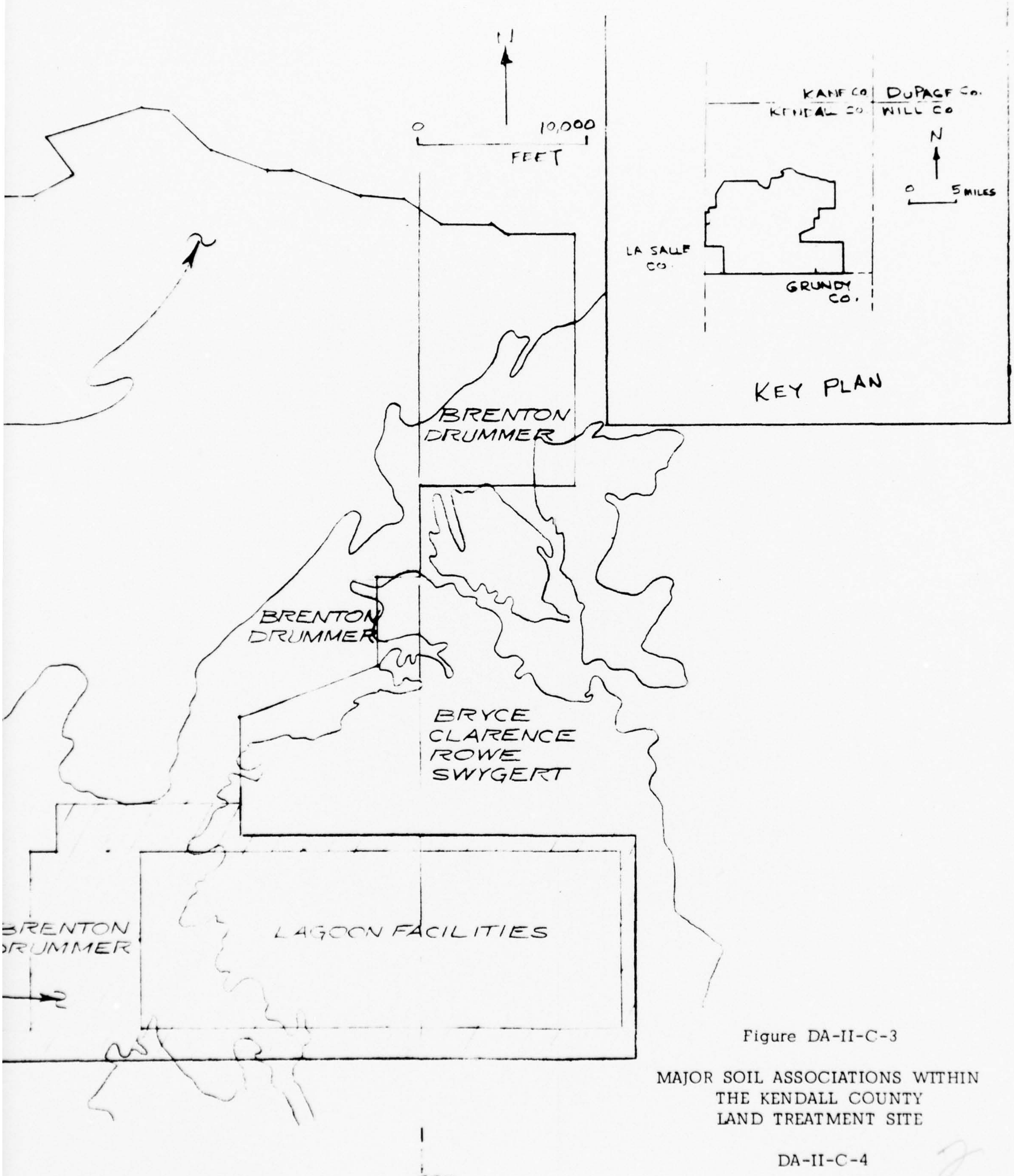
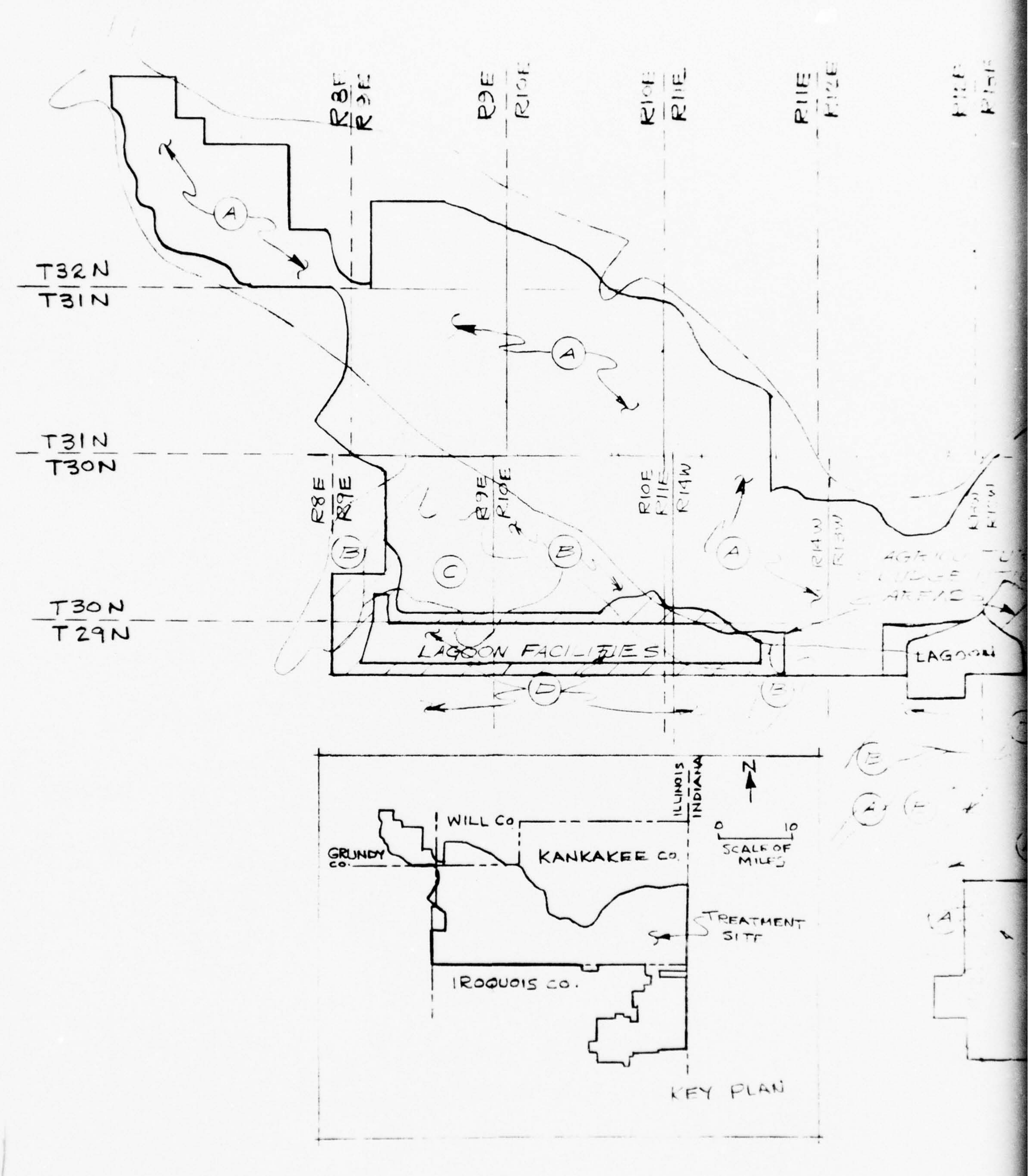


Figure DA-II-C-3

MAJOR SOIL ASSOCIATIONS WITHIN THE KENDALL COUNTY LAND TREATMENT SITE



R8E
R9E
R9E
R10E
R10E
R11E
R11E
R12E
T32N
T31N
T31N
T30N
T30N
T29N
R8E
R9E
R9E
R10E
R10E
R11E
R14W
R14W
R13W
A
A
A
B
B
C
D
LAGOON FACILITIES
LAGOON
ILLINOIS
INDIANA
N
0
10
SCALE OF MILES
WILL CO
GRUNDY CO.
KANKAKEE CO.
TREATMENT SITE
IROQUOIS CO.
KEY PLAN

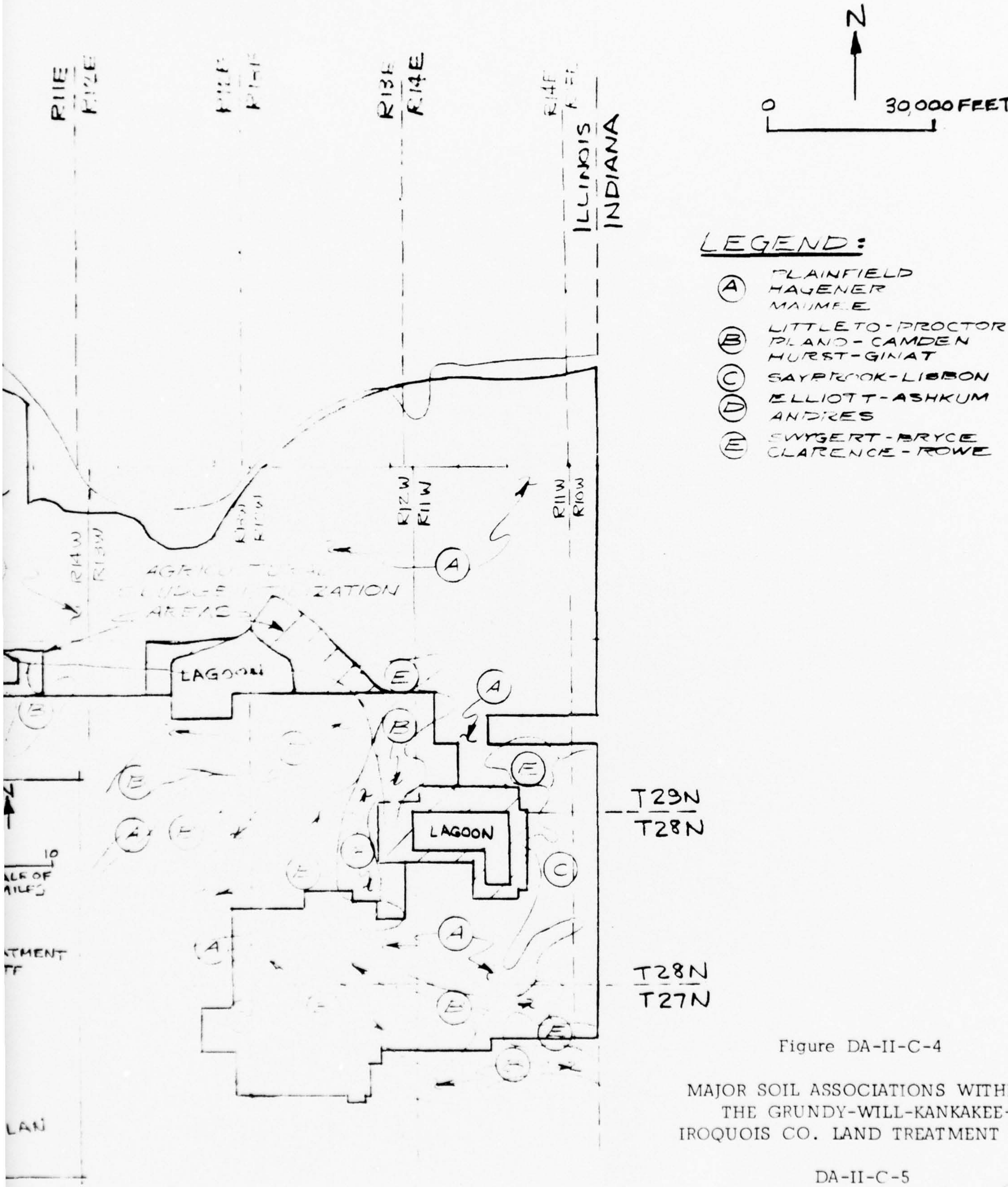
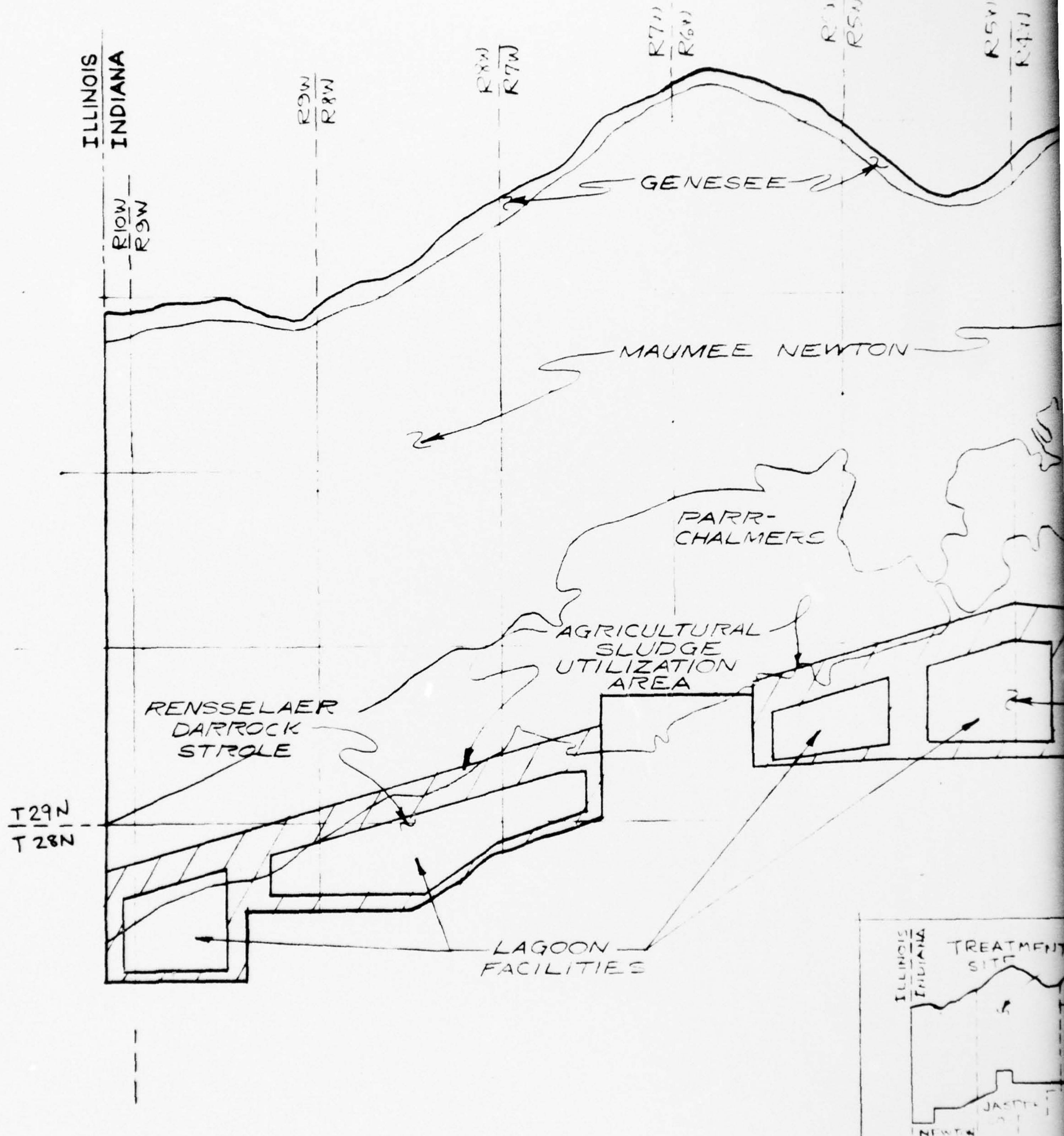
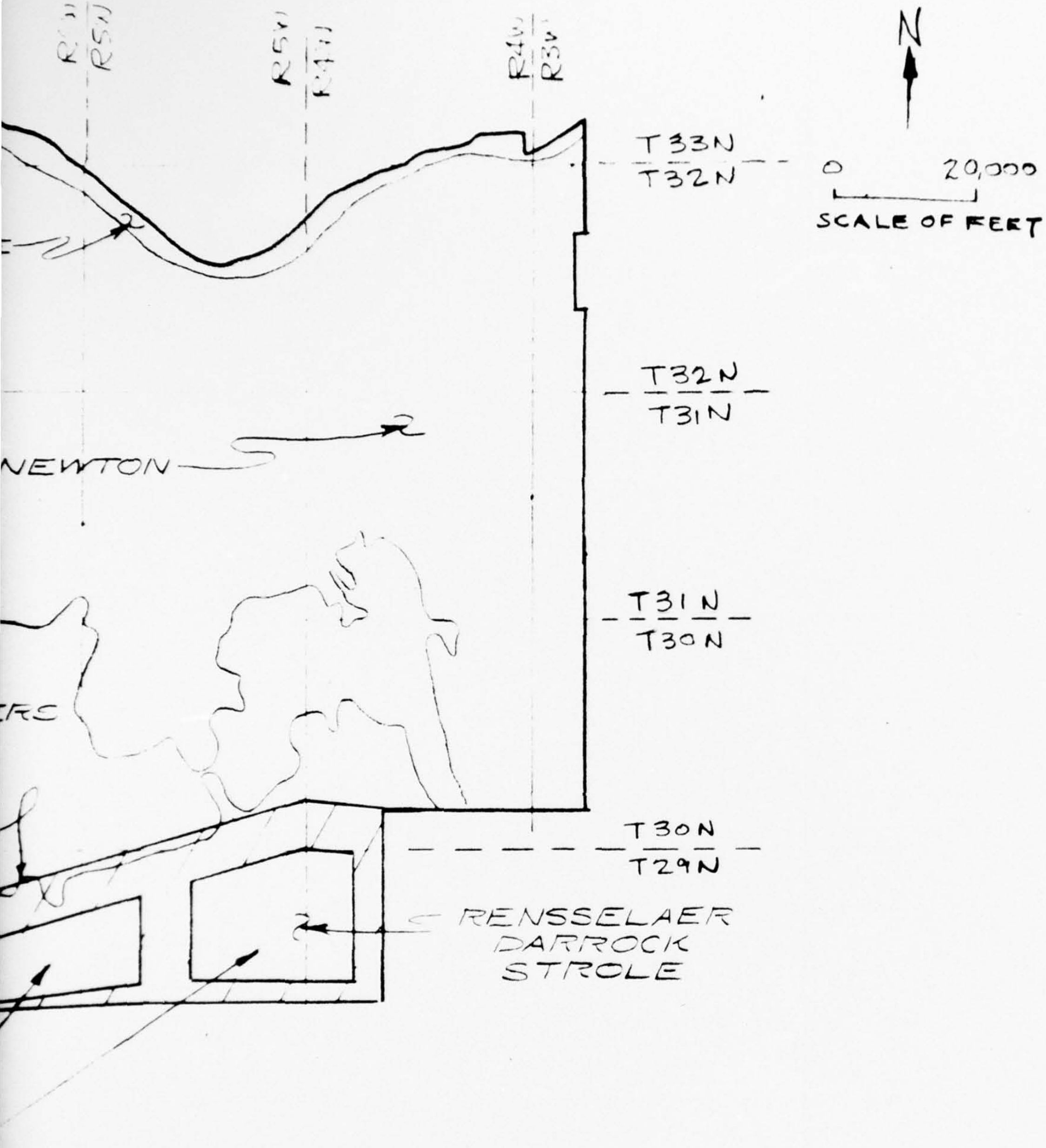


Figure DA-II-C-4

MAJOR SOIL ASSOCIATIONS WITHIN THE GRUNDY-WILL-KANKAKEE-IROQUOIS CO. LAND TREATMENT SITE



ILLINOIS
INDIANA
R10W
R9W
R9W
R8W
R8W
R7W
R7W
R6W
R5W
R5W
R4W
GENESEE
MAUMEE NEWTON
PARR-
CHALMERS
AGRICULTURAL
SLUDGE
UTILIZATION
AREA
RENSSELAER
DARROCK
STROLE
T29N
T28N
LAGOON
FACILITIES
ILLINOIS
INDIANA
TREATMENT
SITE
NEWTON



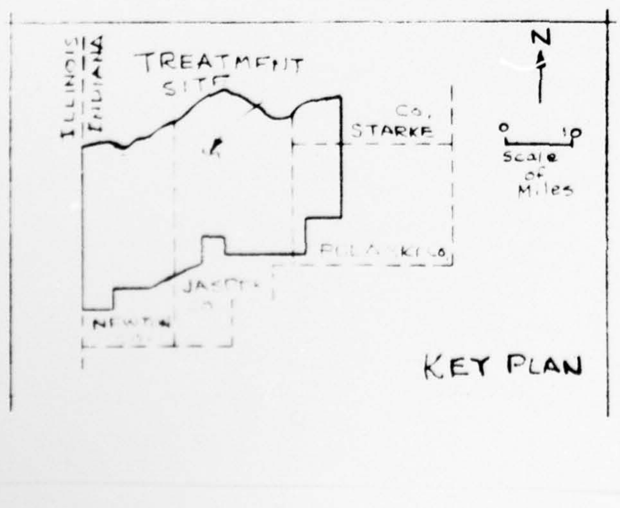
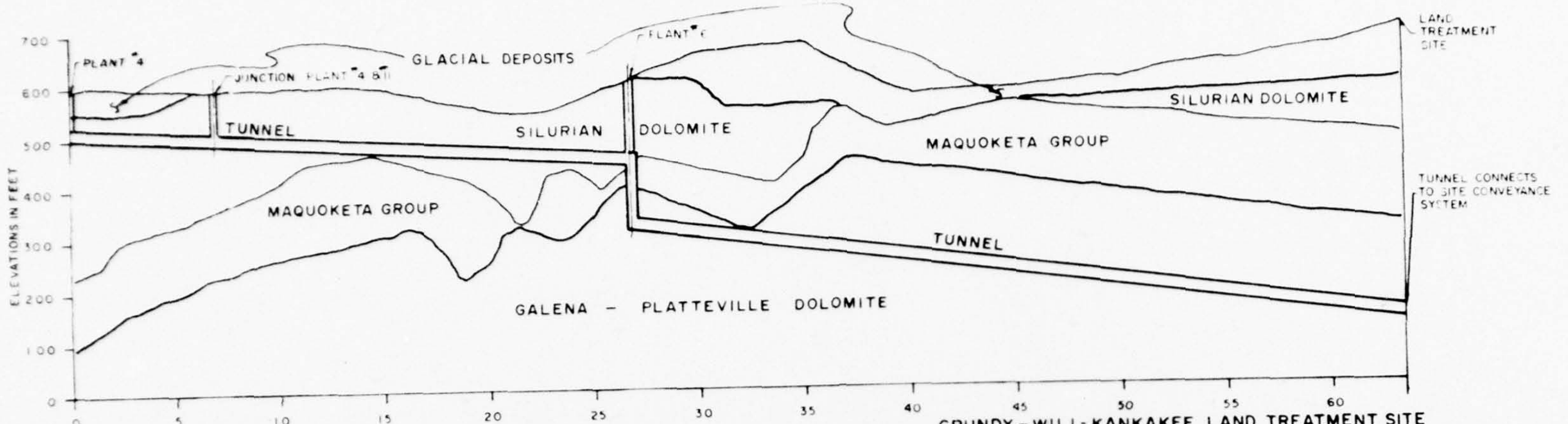
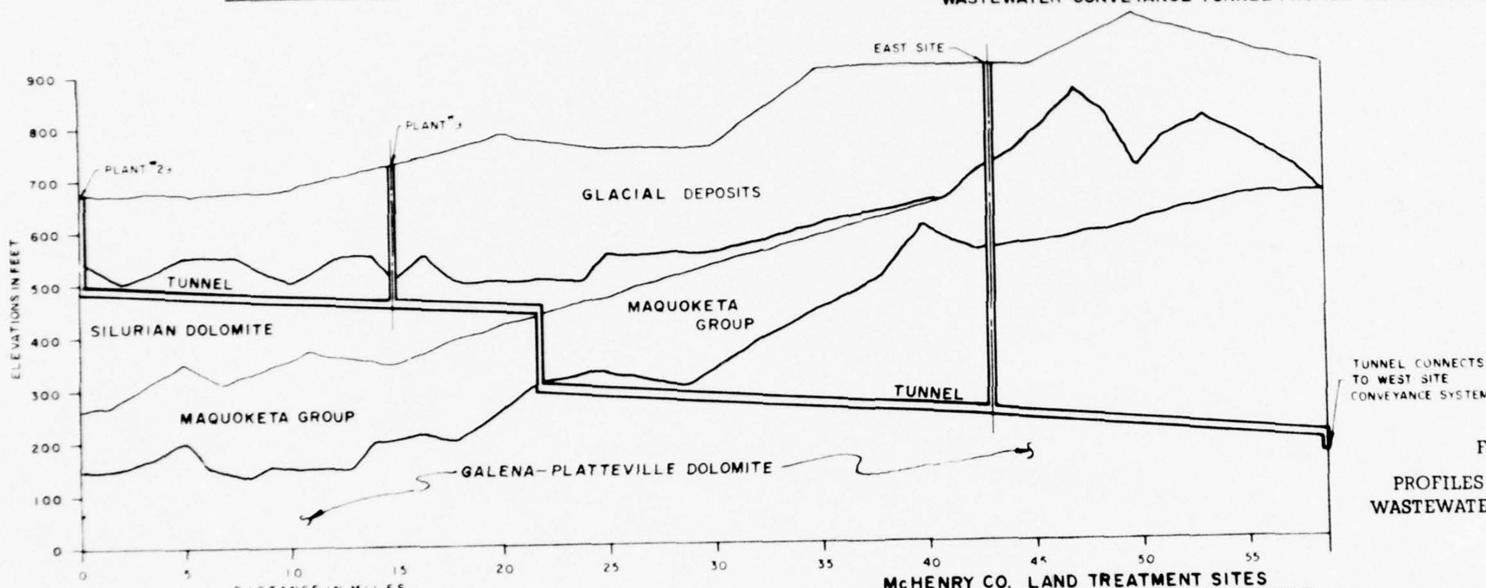


Figure DA-II-C-5

MAJOR SOIL ASSOCIATIONS WITHIN THE NEWTON-JASPER-PULASKI-STARKE LAND TREATMENT SITE



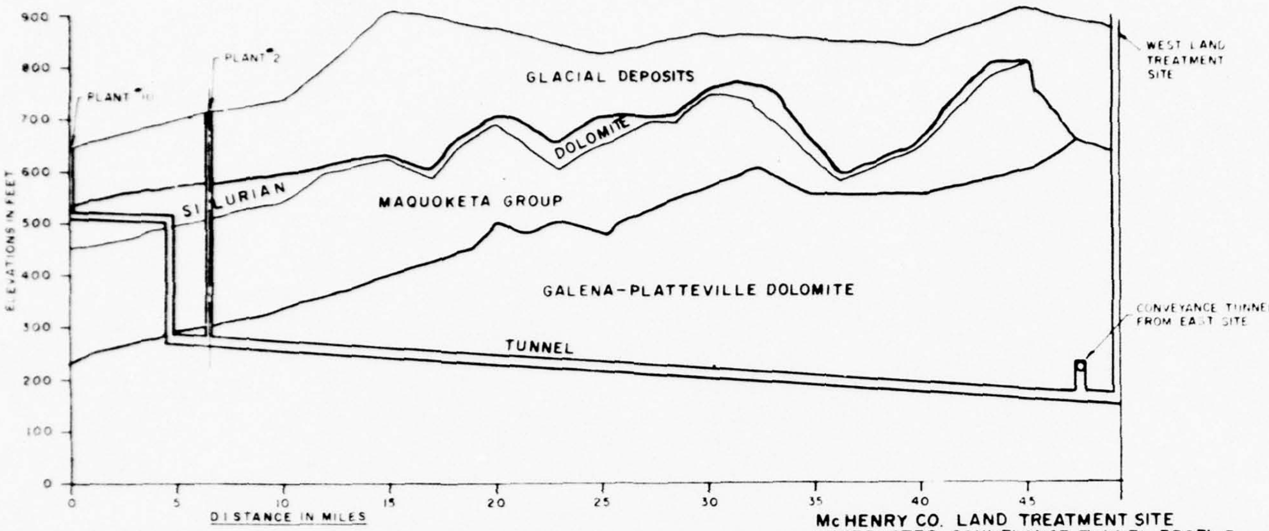
GRUNDY-WILL-KANKAKEE LAND TREATMENT SITE
WASTEWATER CONVEYANCE TUNNEL PROFILE ALTERNATIVE IV



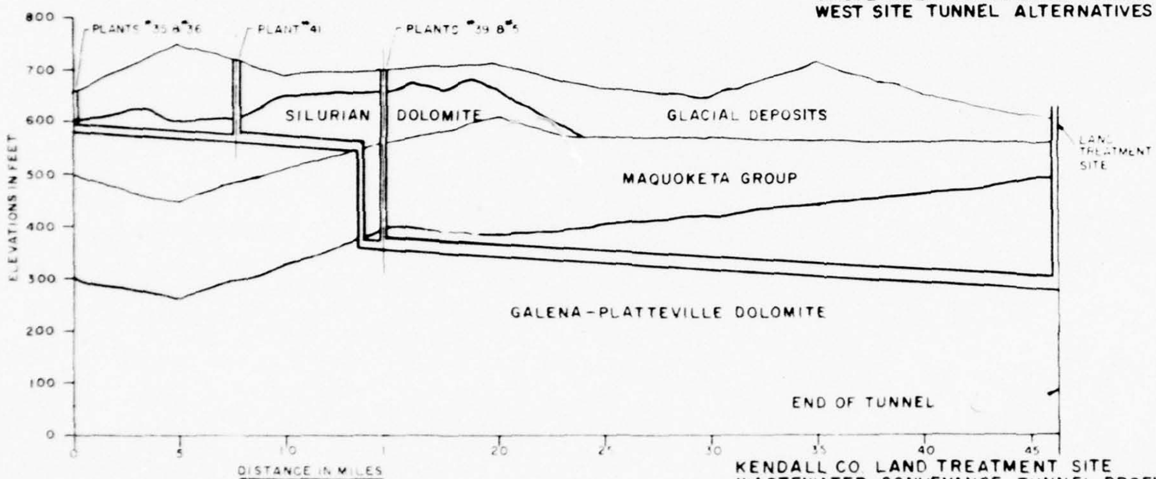
McHENRY CO. LAND TREATMENT SITES
WASTEWATER CONVEYANCE TUNNEL PROFILE
EAST SITE TO WEST SITE TUNNEL ALTERNATIVES IV & V

Figure DA-II-C-6

PROFILES FOR LAND TREATMENT
WASTEWATER CONVEYANCE TUNNELS

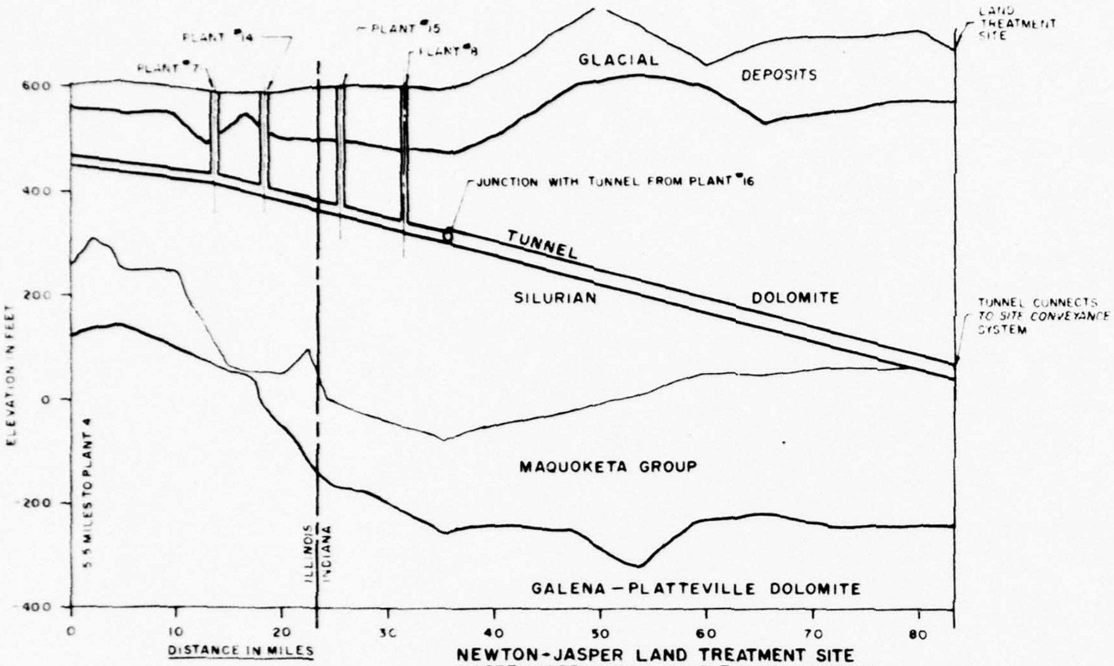


McHENRY CO. LAND TREATMENT SITE
WASTEWATER CONVEYANCE TUNNEL PROFILE
WEST SITE TUNNEL ALTERNATIVES IV & V

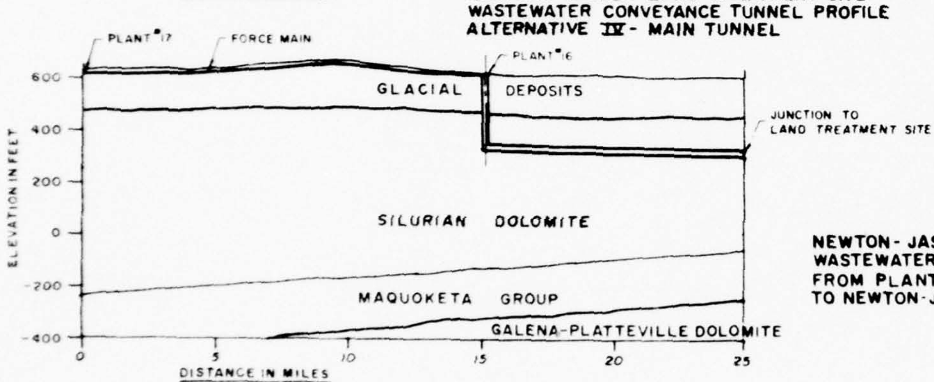


KENDALL CO. LAND TREATMENT SITE
WASTEWATER CONVEYANCE TUNNEL PROFILE
ALTERNATIVES IV & V

Figure DA-II-C-6 (Continued)

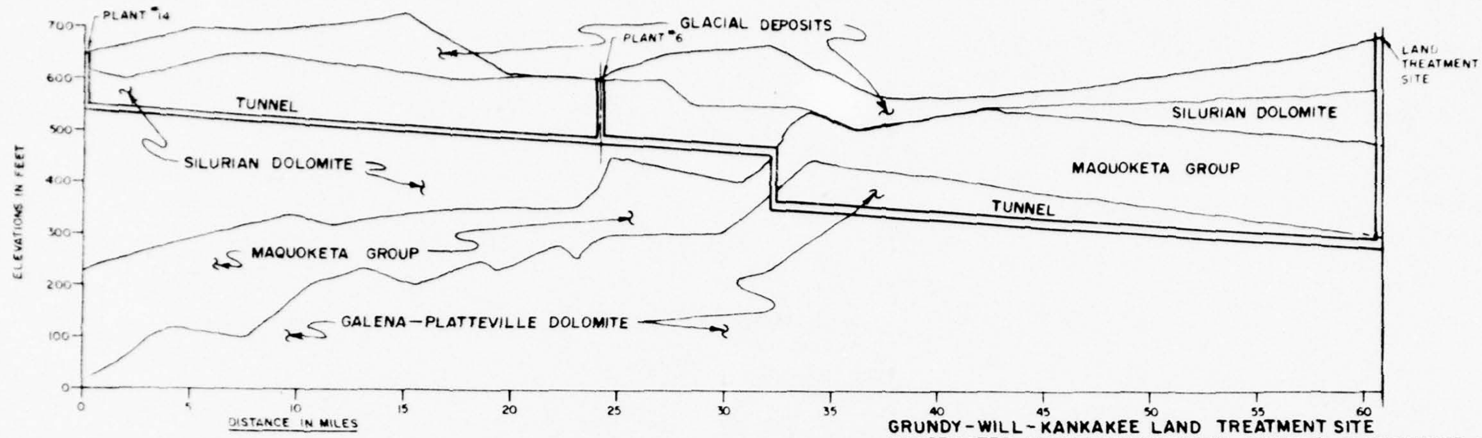


NEWTON-JASPER LAND TREATMENT SITE
WASTEWATER CONVEYANCE TUNNEL PROFILE
ALTERNATIVE IV - MAIN TUNNEL

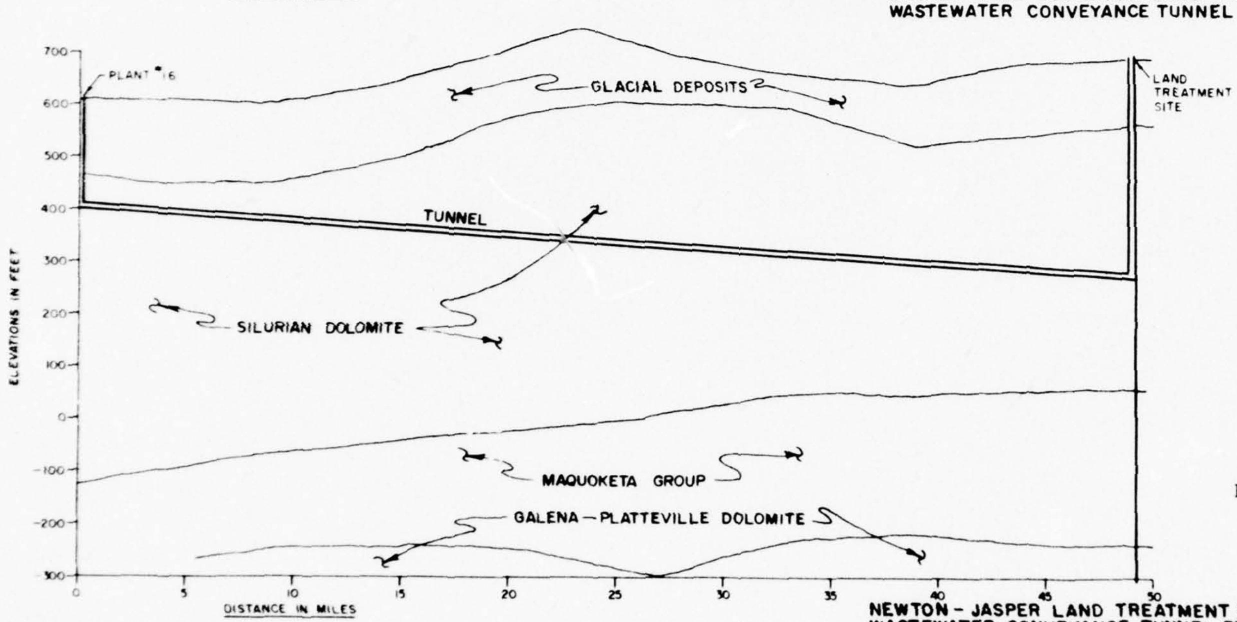


NEWTON-JASPER LAND TREATMENT SITE
WASTEWATER CONVEYANCE TUNNEL PROFILE
FROM PLANT 16 TO JUNCTION WITH MAIN TUNNEL
TO NEWTON-JASPER LAND TREATMENT SITE

Figure DA-II-C-6 (Continued)



GRUNDY-WILL-KANKAKEE LAND TREATMENT SITE
WASTEWATER CONVEYANCE TUNNEL PROFILE ALTERNATIVE V



NEWTON-JASPER LAND TREATMENT SITE
WASTEWATER CONVEYANCE TUNNEL PROFILE ALTERNATIVE V

Figure DA-II-C-6 (Continued)

be designed for optimized slopes which correspond with maximum tunnel size and minimum wastewater lifts at land site pumping facilities. These profiles were also utilized to determine the lift and hence the capital and O & M costs of the main wastewater pump stations at the land treatment sites.

The profiles for the reuse tunnels associated with the land treatment sites of Alternatives IV and V are presented in Figure DA-II-C-7. The basis of design for these reuse tunnels is the same as that for the wastewater conveyance tunnels. The profiles of these tunnels are utilized to determine the capital and O & M costs of the reuse lift stations for the reuse management system of Alternatives IV and V. The alignment of these reuse tunnels are presented in Section IV-G, Appendix B.

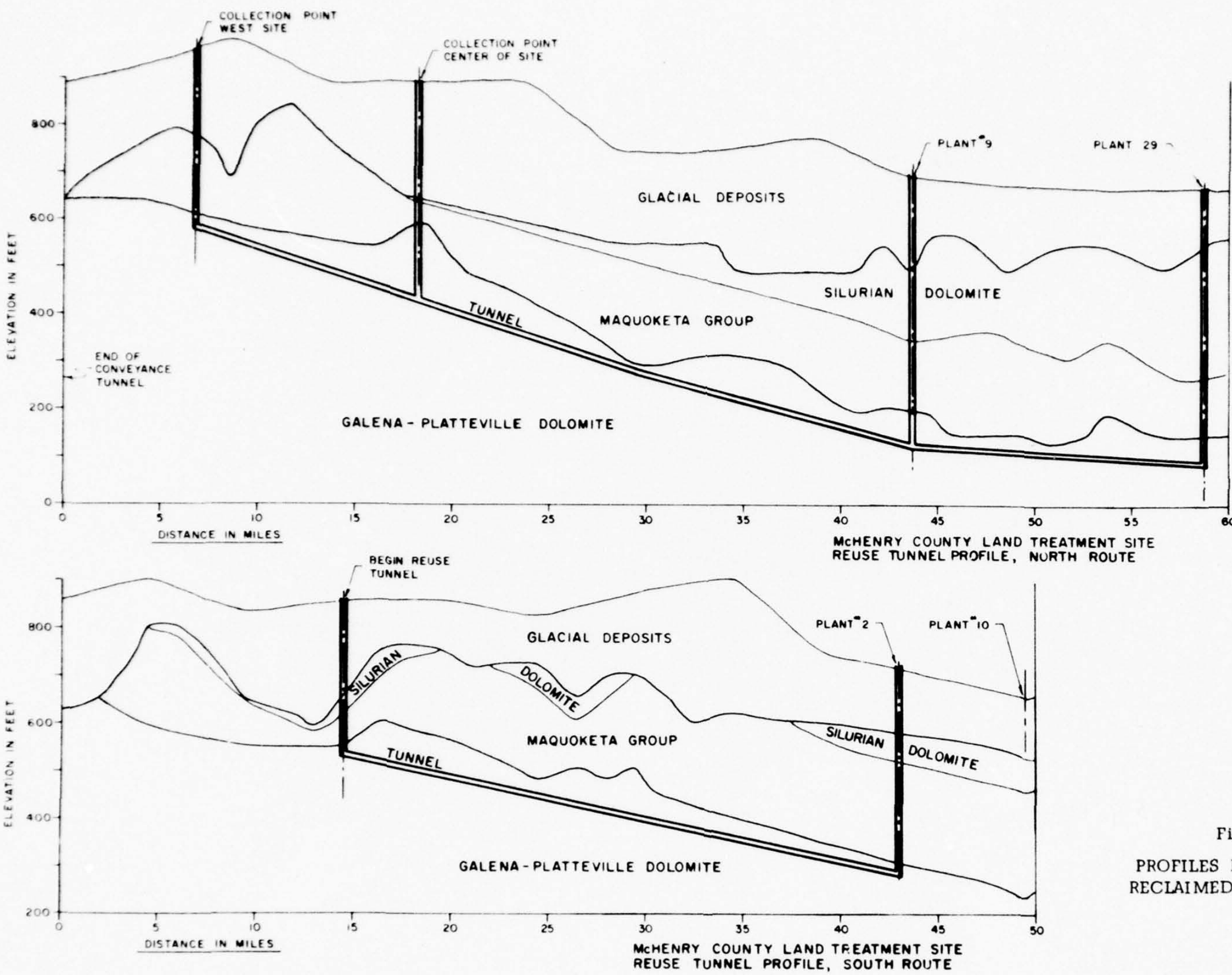


Figure DA-II-C-7

PROFILES FOR LAND TREATMENT
RECLAIMED WATER REUSE TUNNELS

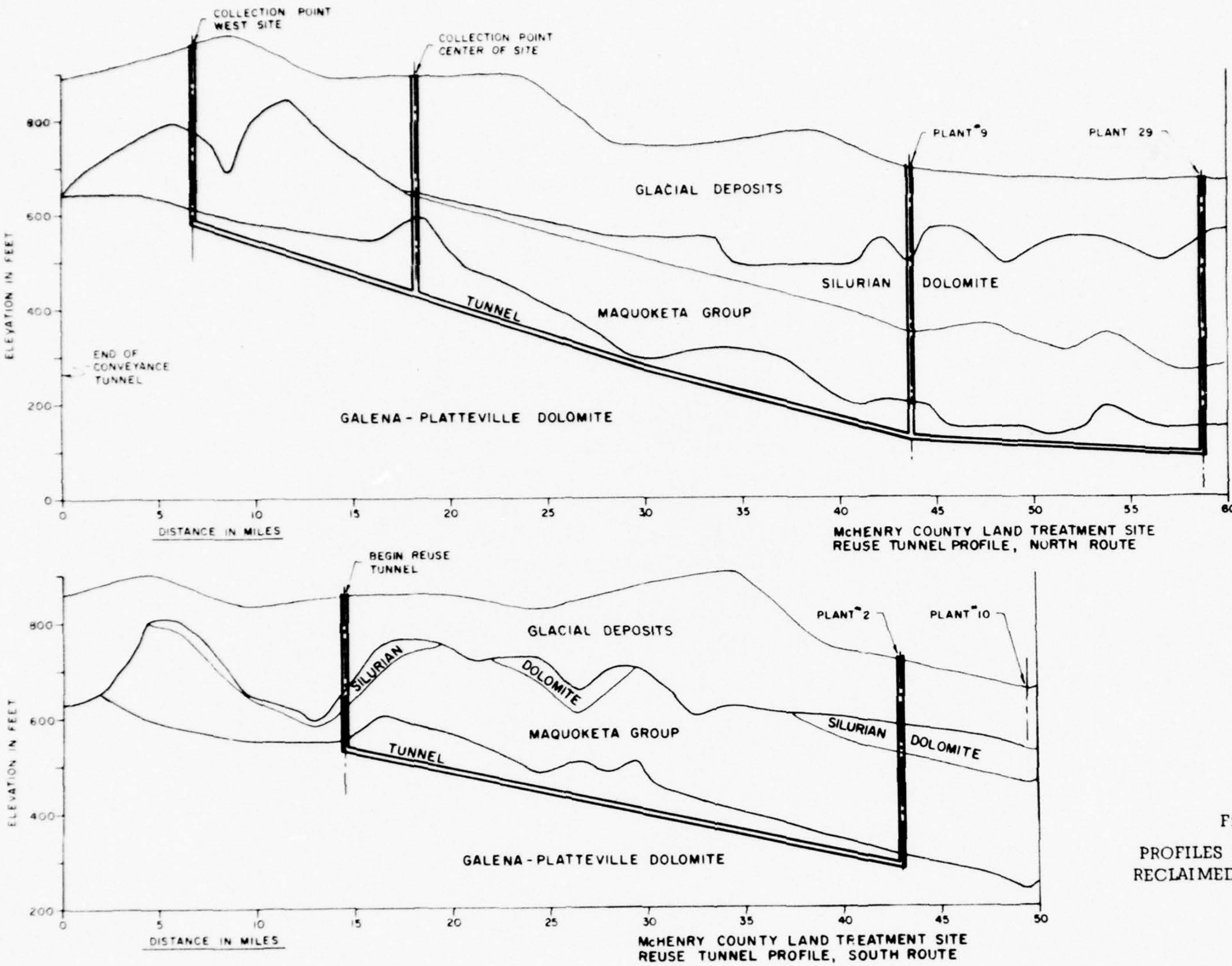
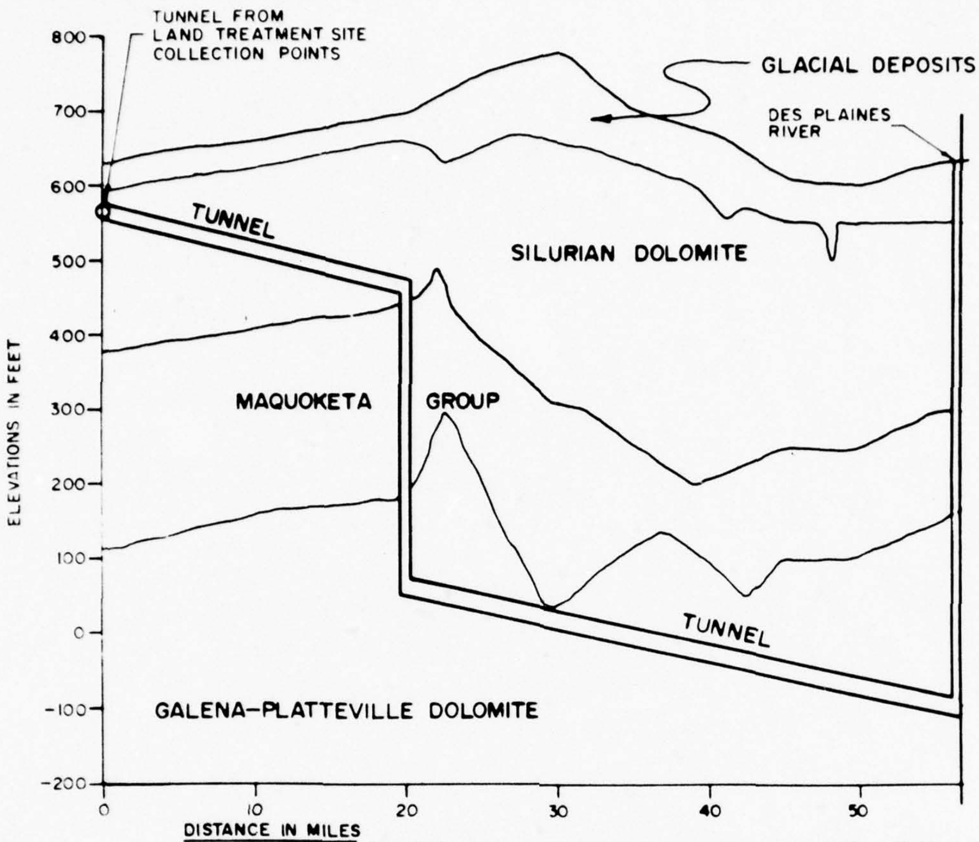
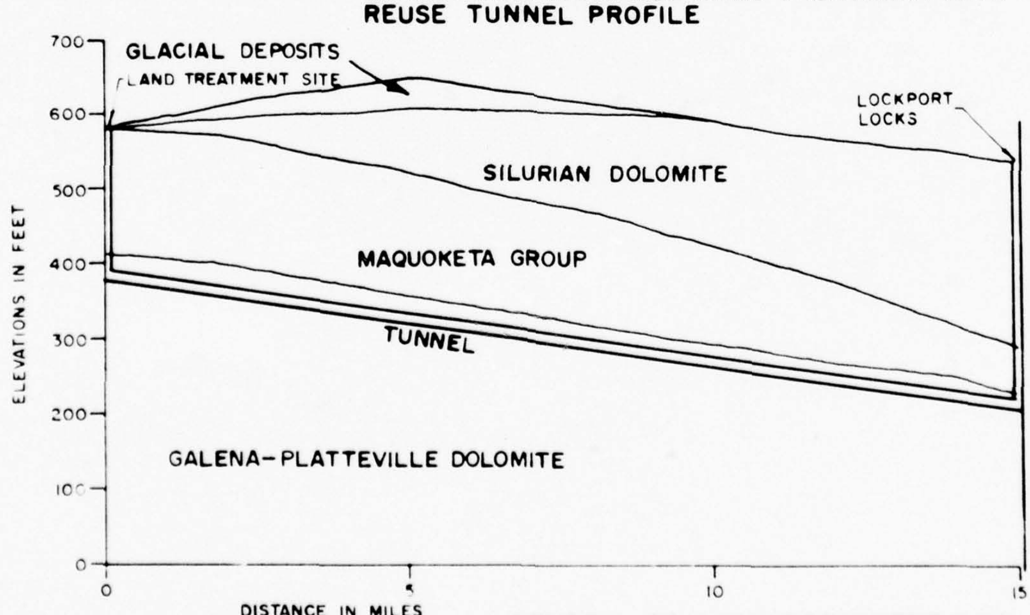


Figure DA-II-C-7

PROFILES FOR LAND TREATMENT
RECLAIMED WATER REUSE TUNNELS

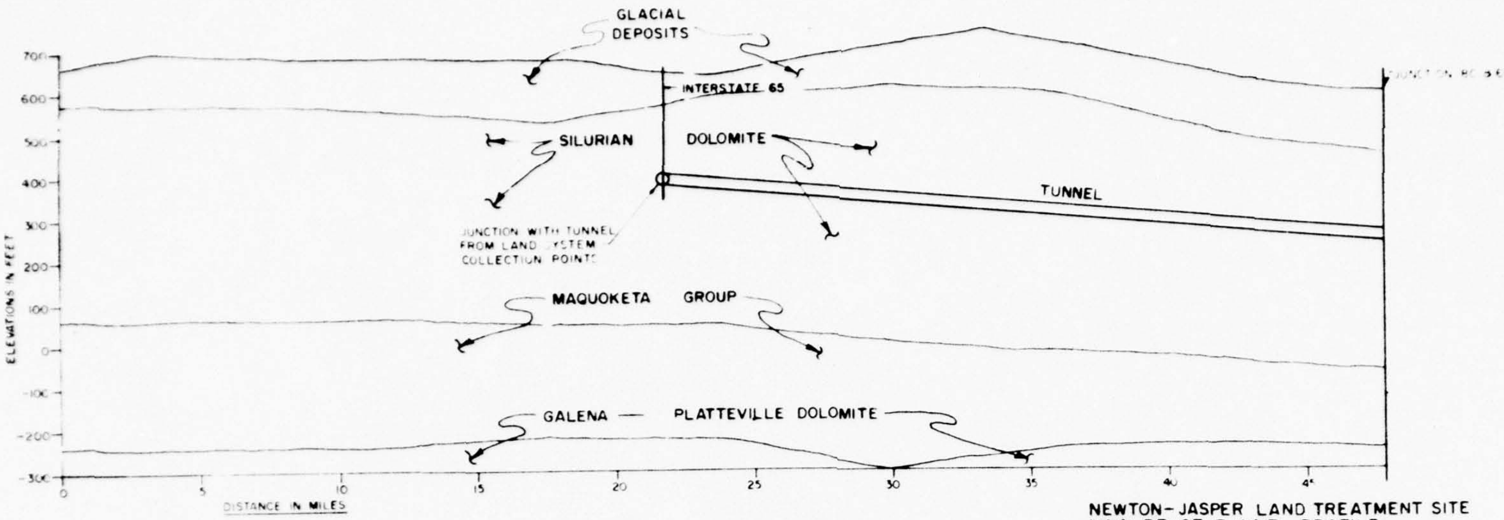


GRUNDY-WILL-KANKAKEE LAND TREATMENT SITE
REUSE TUNNEL PROFILE

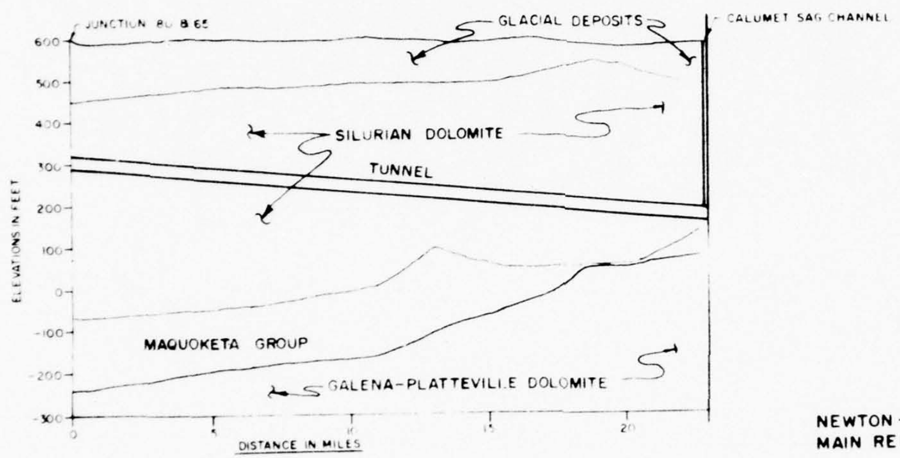


KENDALL CO. LAND TREATMENT SITE
REUSE TUNNEL PROFILE

Figure DA-II-C-7 (Continued)



NEWTON-JASPER LAND TREATMENT SITE
MAIN REUSE TUNNEL PROFILE



NEWTON-JASPER LAND TREATMENT SITE
MAIN REUSE TUNNEL EXTENSION PROFILE

Figure DA-II-C-7 (Continued)

DATA ANNEX D

IV. COST OF REGIONAL WASTEWATER MANAGEMENT ALTERNATIVES

IV. COST OF REGIONAL WASTEWATER MANAGEMENT ALTERNATIVES

C. ALTERNATIVE COSTS

PURPOSE

The purpose of this section is to provide a cost estimation methodology to interested persons which allows them to produce the capital cost figures for any portion of the C-SELM area. Such an estimation is accomplished by normalizing the costs of each of the regional wastewater management system components (except treatment facilities) with a simple and readily available unit. In most cases this has been done by either square miles or millions of gallons of flow per day (MGD).

With unit costs for each system component, a total, aggregated cost which includes contingencies and engineering and administrative costs can be created.

The following discussion will present a component by component presentation of the unit costs.

In addition to the capital expenditure modeling, a generalized procedure is presented which allows the reader to establish the present-worth costs of not only the capital expenditure, but also the operation and maintenance costs, and the replacement costs for any part of the selected alternative. The sum of these three present-worth costs provides a meaningful estimate of total costs associated with a selected portion of the overall study area.

TREATMENT FACILITIES

Treatment facilities are the only exception to the unit cost approach. Tables DA-IV-C-1 through DA-IV-C-5 present the individual treatment facility costs for Alternatives I through V, respectively. By referring to the particular alternative in which he is interested, a person can find the plant closest to his management area and identify the capital costs for this plant. Plant locations are shown in Figures D-IV-C-1 through D-IV-C-5, for Alternatives I through V, respectively. If the service areas are not entirely within an area under consideration, an estimate of the costs associated with a given area can be accomplished on a straight percentage of population served by the selected plant. Population figures are presented in Tables D-II-C-1 through D-II-C-5, respectively.

CONVEYANCE SYSTEMS

Table DA-IV-C-6 presents conveyance capital construction costs normalized by square miles of service areas for Alternatives I through V. An estimated total for the conveyance system capital cost can be obtained for any area by using the given unit cost and the square mile area of the service area in question.

Table DA-IV-C-1

ALTERNATIVE I TREATMENT FACILITY COSTS

MAP REF NO.	NAME	CAPITAL COSTS [4] ($ MILLION)				ANNUAL CAPITAL COST [5] ($ MILLION)		ANNUAL REPLACEMENT COST [6] ($ MILLION)		O & M COST [7] ($ MILLION)		TOTAL ANNUAL COST [8] ($ MILLION)	
		TREATMENT FACILITY		STORAGE									
		1990	2020	1990	2020	1990	2020	1990	2020	1990	2020	1990	2020
18	Lindenhurst	1.9	4.0	0.3	1.0	0.13	0.29	0.02	0.04	0.10	0.23	0.25	0.56
19	Granwood Park	2.5	4.5	0.5	1.1	0.18	0.33	0.02	0.04	0.14	0.26	0.34	0.63
9	Gurnee	11.8	19.6	2.8	4.1	0.86	1.40	0.11	0.18	0.64	0.95	1.61	2.53
20	Waukegan	12.7	22.2	2.6	6.0	0.90	1.66	0.19	0.25	1.04	1.32	2.13	3.23
21	Victory Manor	2.8	4.9	0.6	1.3	0.20	0.37	0.03	0.04	0.16	0.28	0.39	0.69
24	Libertyville	2.3	4.6	1.0	1.8	0.20	0.38	0.03	0.04	0.19	0.30	0.42	0.72
22	Sylan Lake	1.3	2.9	0.2	0.7	0.09	0.21	0.01	0.03	0.08	0.16	0.18	0.40
23	Mundelein	–	0.7	0.4	0.7	0.03	0.08	0.02	0.03	0.13	0.18	0.18	0.29
26	Vernon Hills	2.3	3.0	0.4	0.7	0.16	0.22	0.02	0.03	0.13	0.17	0.31	0.42
25	New Mundelein	3.0	4.4	0.6	1.1	0.21	0.33	0.03	0.04	0.16	0.25	0.40	0.62
28	Lake Zurich East	1.0	2.7	0.1	0.6	0.07	0.20	0.01	0.02	0.06	0.16	0.14	0.38
27	Ela	1.0	2.8	0.1	0.6	0.07	0.20	0.01	0.03	0.06	0.16	0.14	0.39
29	Des Plaines	8.3	17.3	1.8	3.8	0.60	1.24	0.08	0.16	0.43	0.83	1.11	2.23
10	O'Hare	46.0	59.4	–	–	2.71	3.50	0.41	0.54	2.27	2.66	5.39	6.70
2	Salt Creek	–	3.8	5.0	5.3	0.3	0.54	0.25	0.27	1.11	1.40	1.66	2.21
33,34	Addison	13.9	21.4	3.4	4.9	1.02	1.55	0.15	0.22	0.82	1.13	1.99	2.90
35,36	Elmhurst	2.9	5.0	2.0	2.6	0.29	0.45	0.06	0.08	0.37	0.45	0.72	0.98
11	Hinsdale	7.4	16.1	2.7	4.3	0.60	1.20	0.09	0.17	0.51	0.89	1.20	2.26
43	Romeoville	4.0	6.5	1.4	2.1	0.31	0.51	0.04	0.06	0.23	0.35	0.58	0.92
1	Deerfield	1.1	4.1	0.9	1.1	0.12	0.31	0.04	0.05	0.23	0.28	0.39	0.64
30	Clavey Road	4.9	4.9	3.2	3.2	0.48	0.48	0.16	0.16	0.76	0.76	1.40	1.40
3	North Side	124.7	175.6	–	–	7.36	10.36	3.54	4.00	14.62	16.09	25.52	30.45
4	West Southwest	244.0	316.0	–	–	14.40	18.64	9.01	9.90	34.87	37.70	58.28	[illegible]
15	Hammond	152.7	152.7	–	–	9.01	9.01	1.65	1.65	7.45	5.39	18.11	[illegible]
7	Calumet	254.1	342.4	–	–	14.99	20.20	4.13	4.90	15.61	18.05	34.73	43.15

Table DA-IV-C-1 (Continued)

MAP REF. NO.	NAME	CAPITAL COSTS[4] ($ MILLION) TREATMENT FACILITY 1990	TREATMENT FACILITY 2020	STORAGE 1990	STORAGE 2020	ANNUAL CAPITAL COST[5] ($ MILLION) 1990	2020	ANNUAL REPLACEMENT COST[6] ($ MILLION) 1990	2020	O & M COST[7] ($ MILLION) 1990	2020	TOTAL ANNUAL COST[8] ($ MILLION) 1990	2020
58	Township U.C.	2.3	3.7	0.4	0.9	0.16	0.28	0.02	0.03	0.13	0.22	0.31	0.53
14	Bloom	8.6	16.4	3.9	4.8	0.74	1.25	0.14	0.22	0.81	1.04	1.69	2.51
59	East Chicago Heights	4.1	24.9	4.7	5.5	0.52	1.80	0.20	0.24	0.94	1.14	1.66	3.18
57	Wood Hill	6.0	11.2	1.4	2.6	0.44	0.82	0.05	0.10	0.33	0.58	0.82	1.50
44	Lemont	15.8	18.3	4.5	4.6	1.20	1.35	0.14	0.16	0.71	0.79	2.05	2.30
49	Lockport	5.9	7.7	2.3	3.3	0.48	0.65	0.05	0.07	0.32	0.42	0.85	1.14
47	Derby Meadows	0.6	3.3	0.3	0.8	0.06	0.24	0.01	0.03	0.08	0.19	0.15	0.46
46	Chickasaw Hill	1.6	3.2	0.3	0.8	0.11	0.24	0.01	0.03	0.08	0.17	0.20	0.44
45	Lockport Heights	1.7	3.4	0.3	0.9	0.12	0.25	0.02	0.03	0.08	0.18	0.22	0.46
54	Prestwick U.C.	2.3	4.3	0.4	1.1	0.16	0.32	0.02	0.04	0.13	0.25	0.31	0.61
53	Mokena-Frankfort	3.2	7.1	0.7	1.8	0.23	0.52	0.03	0.06	0.18	0.40	0.44	0.98
52	New Lenox	2.9	6.6	0.7	1.8	0.21	0.49	0.03	0.06	0.14	0.34	0.38	0.89
51	Oak Highlands	4.8	8.2	1.4	2.3	0.37	0.62	0.04	0.07	0.25	0.42	0.66	1.11
6	Joliet	6.9	15.8	3.0	6.4	0.59	1.31	0.18	0.26	0.94	1.33	1.71	2.90
13	West Joliet	6.6	8.8	2.0	3.1	0.51	0.70	0.06	0.08	0.36	0.48	0.93	1.26
56	Manhattan	1.3	2.2	0.2	0.4	0.10	0.15	0.01	0.02	0.08	0.12	0.19	0.29
55	Elmwood	4.1	4.1	0.6	0.6	0.27	0.27	0.04	0.04	0.23	0.19	0.54	0.50
31	Hanover	1.8	7.2	1.4	1.9	0.19	0.54	0.05	0.06	0.30	0.40	0.54	1.00
32	Bartlett	3.3	5.7	0.8	1.6	0.24	0.43	0.03	0.05	0.17	0.30	0.44	0.78
39	West Chicago	6.7	17.7	2.0	3.9	0.51	1.27	0.08	0.18	0.46	0.96	1.05	2.41
40	National Accelerator Laboratory	—	2.6	0.5	1.1	0.03	0.22	0.02	0.03	0.10	0.19	0.15	0.44
38	Wheaton	6.0	10.2	2.1	3.0	0.48	0.78	0.08	0.12	0.48	0.68	1.04	1.58
5	Springbrook	8.0	12.2	2.2	4.3	0.60	0.97	0.07	0.11	0.44	0.89	1.11	1.97
37	Glen Ellyn	14.2	22.0	3.0	4.4	1.02	1.56	0.14	0.21	0.80	[illegible]	2.02	2.88
41	Downers Grove	5.5	8.1	2.1	2.8	0.45	0.64	0.08	0.11	0.49	0.61	1.02	1.36

Table DA-IV-C-1 (Continued)

MAP REF NO.	NAME	CAPITAL COSTS[4] ($ MILLION) TREATMENT FACILITY 1990	TREATMENT FACILITY 2020	STORAGE 1990	STORAGE 2020	[5] ANNUAL CAPITAL COST ($ MILLION) 1990	2020	[6] ANNUAL REPLACEMENT COST ($ MILLION) 1990	2020	[7] O & M COST ($ MILLION) 1990	2020	[8] TOTAL ANNUAL COST ($ MILLION) 1990	2020
12	Lisle	11.3	17.1	2.7	3.7	0.83	1.23	0.10	0.15	0.57	0.82	1.50	2.20
48	Plainfield	2.0	57	0.4	1.8	0.14	0.44	0.02	0.05	0.10	0.32	0.26	0.81
42	Citizens West Suburban	3.1	6.1	0.7	1.5	0.23	0.45	0.03	0.06	0.17	0.34	0.43	0.85
50	Will County	2.6	6.1	0.7	1.9	0.20	0.47	0.02	0.06	0.09	0.33	0.31	0.86
60	East Chicago	206	20.6	–	–	1.21	1.21	0.29	0.29	2.41	1.57	3.91	3.07
8	Gary	47.8	50.8	–	–	2.82	3.00	0.75	0.76	5.41	5.54	8.98	9.30
61	Crown Point	3.1	52	0.8	1.6	0.23	0.40	0.03	0.05	0.21	0.39	0.47	0.84
62	Hobart	6.3	14.8	2.1	3.8	0.50	1.10	0.07	0.14	0.58	1.23	1.15	2.47
63	Portage	15.7	394	2.0	8.7	1.04	2.84	0.14	0.36	1.22	2.94	2.40	6.14
64	Chesterton	14.4	239	1.0	7.5	0.91	1.85	0.13	0.22	1.11	1.79	2.15	3.86
65	Valparaiso	–	4.2	0.8	1.8	0.05	0.35	0.03	0.05	0.20	0.44	0.28	0.84
17	Michigan City	4.6	86	2.2	3.3	0.40	0.70	0.06	0.10	0.56	0.88	1.02	1.68

Table DA-IV-C-2

ALTERNATIVE II TREATMENT FACILITY COSTS

MAP REF NO	NAME	CAPITAL COSTS 4 ($ MILLION) TREATMENT FACILITY 1990	2020	STORAGE 1990	2020	5 ANNUAL CAPITAL COST ($ MILLION) 1990	2020	6 ANNUAL REPLACEMENT COST ($ MILLION) 1990	2020	7 O & M COST ($ MILLION) 1990	2020	8 TOTAL ANNUAL COST ($ MILLION) 1990	2020
9	Gurnee	27.4	61.3	2.6	3.2	1.77	3.80	0.50	1.07	2.35	4.30	4.62	9.17
20	Waukegan	36.4	56.5	–	–	2.15	3.33	0.67	0.98	3.23	4.29	6.05	8.60
24	Libertyville	47.9	87.3	0.7	1.4	2.87	5.23	0.88	1.54	2.84	5.33	6.59	12.10
29	Des Plaines	67.4	110.2	1.2	2.4	4.05	6.65	1.24	1.98	4.02	6.51	9.31	15.14
10	O'Hare	115.4	146.3	–	–	6.81	8.63	2.12	2.65	8.26	10.35	17.19	21.63
2	Salt Creek	82.1	110.4	1.8	1.8	4.95	6.62	1.51	1.99	6.23	7.55	12.69	16.16
33-34	Addison	74.5	94.2	–	–	4.39	5.56	1.37	1.68	4.74	6.04	10.50	13.28
35-36	Elmhurst	53.7	58.9	–	–	3.17	3.48	0.99	1.05	3.22	3.50	7.38	8.03
11	Hinsdale	65.3	72.1	–	–	3.85	4.25	1.20	1.27	3.99	4.35	9.04	9.87
43	Romeoville	22.0	42.6	0.7	1.5	1.34	2.61	0.40	0.72	1.56	2.81	3.30	6.14
30	Clavey Road	21.4	21.4	–	–	1.26	1.26	0.39	0.39	2.08	2.08	3.73	3.73
3	North Side	505.8	568.3	–	–	29.84	33.53	9.31	10.44	38.46	42.42	77.61	86.39
4	West-Southwest	1259.5	1384.7	–	–	74.31	81.70	23.18	25.48	90.71	98.63	188.20	205.81
15	Hammond	246.0	246.0	–	–	14.51	14.51	4.53	3.56	20.07	15.08	39.11	33.15
7	Calumet	584.1	696.1	–	–	34.46	41.07	10.75	12.81	41.06	47.47	86.27	101.35
14	Bloom	54.5	95.6	1.8	3.4	3.32	5.84	1.00	1.71	4.05	6.38	8.37	13.93
59	East Chicago Heights	61.9	81.5	–	–	3.65	4.81	1.14	1.44	4.24	5.19	9.03	11.44
44	Lemont	33.2	68.4	3.5	3.8	2.16	4.26	0.61	1.20	2.64	4.47	5.41	9.93
53	Mokena-Frankfort	31.1	66.1	0.7	[illegible]	1.88	4.00	0.57	1.16	1.95	4.03	4.40	9.19
6	Joliet	84.0	155.1	4.5	6.6	5.22	9.54	1.55	2.84	6.28	10.47	13.05	22.85
13	West Joliet	18.6	47.8	2.7	5.0	1.26	3.11	0.34	0.81	1.69	3.70	3.29	7.62
39	West Chicago	41.8	67.9	0.5	1.1	2.49	4.07	0.77	1.19	2.71	4.54	5.97	9.80
38	Wheaton	24.3	39.4	0.1	0.1	1.44	2.33	0.45	0.67	1.84	2.69	3.73	5.69
5	Springbrook	22.9	53.7	0.8	1.3	1.40	3.24	0.42	0.93	1.87	4.00	3.69	8.17
37	Glen Ellyn	41.7	57.2	–	0.7	2.46	3.42	0.77	0.99	3.13	4.15	6.36	8.56

Table DA-IV-C-2 (Continued)

MAP REF NO.	NAME	CAPITAL COSTS [4] ($ MILLION)				ANNUAL CAPITAL COST ($ MILLION) [5]		ANNUAL REPLACEMENT COST ($ MILLION) [6]		O & M COST ($ MILLION) [7]		TOTAL ANNUAL COST ($ MILLION) [8]	
		TREATMENT FACILITY		STORAGE									
		1990	2020	1990	2020	1990	2020	1990	2020	1990	2020	1990	2020
41	Downers Grove	36.5	48.0	–	–	2.16	2.83	0.67	0.83	2.45	3.03	5.28	6.69
12	Lisle	31.1	45.4	0.4	0.9	1.86	2.73	0.57	0.78	2.42	3.30	4.85	6.81
60	East Chicago	58.1	58.1	–	–	3.43	3.43	1.07	0.70	5.37	3.58	9.87	7.71
8	Gary	149.0	161.5	–	–	8.79	9.53	2.74	2.92	11.79	12.39	23.32	24.84
62	Hobart	28.5	62.5	0.8	1.3	1.73	3.74	0.52	1.08	2.20	4.43	4.45	9.25
16	Burns Ditch	45.0	130.8	0.8	4.1	2.70	7.96	0.83	2.41	3.65	9.47	7.18	19.84
64	Chesterton	26.3	46.8	1.0	7.5	1.61	3.20	0.48	0.80	2.53	4.06	4.62	8.06
17	Michigan City	29.6	48.3	–	–	1.75	2.85	0.55	0.83	2.11	3.20	4.41	6.88

Table DA-IV-C-3

ALTERNATIVE III TREATMENT FACILITY COSTS

MAP REF NO.	NAME	CAPITAL COSTS 4 ($ MILLION)				5 ANNUAL CAPITAL COST ($ MILLION)		6 ANNUAL REPLACEMENT COST ($ MILLION)		7 O & M COST ($ MILLION)		8 TOTAL ANNUAL COST ($ MILLION)	
		TREATMENT FACILITY		STORAGE									
		1990	2020	1990	2020	1990	2020	1990	2020	1990	2020	1990	2020
9	Gurnee	181.2	330.4	3.2	4.5	10.96	19.76	2.50	4.54	7.35	13.19	20.81	37.49
29	Des Plaines	147.2	221.1	1.2	2.4	8.83	13.19	2.03	2.98	5.47	8.13	16.33	24.30
10	O'Hare	197.1	252.8	–	–	11.63	14.91	2.72	3.40	8.22	10.40	22.57	28.71
2	Salt Creek	117.0	168.2	1.8	1.8	7.01	10.03	1.95	2.55	6.09	7.48	15.05	20.06
33-34	Addison	214.3	254.9	–	–	12.64	15.04	2.99	3.47	7.41	8.99	23.04	27.50
11	Hinsdale	109.4	119.8	–	–	6.45	7.07	1.55	1.64	3.75	4.14	11.75	12.85
3	North Side	614.3	721.7	–	–	36.24	42.58	11.93	13.39	38.64	42.62	86.81	98.59
4	West-Southwest	1447.2	1661.2	–	–	85.39	98.01	29.70	32.65	91.13	99.09	206.22	229.75
15	Hammond	496.0	496.0	–	–	29.26	29.26	7.14	5.42	25.32	18.42	61.72	53.10
7	Calumet	813.4	1005.0	–	–	47.99	59.29	13.77	16.42	41.25	47.68	103.01	123.39
14	Bloom	188.7	287.4	1.8	3.4	11.34	17.16	2.71	4.03	7.69	11.22	21.74	32.41
6	Joliet	260.1	540.2	11.3	17.1	16.35	32.88	3.77	7.64	11.32	21.89	31.44	62.39
39	West Chicago	139.9	251.2	1.5	2.5	8.40	14.96	1.96	3.47	5.38	10.31	15.74	28.74
41	Downers Grove	206.8	297.3	1.0	3.2	12.39	17.73	2.91	4.11	8.09	11.95	23.39	33.79
8	Gary	263.6	339.3	0.8	1.3	15.63	20.09	4.13	5.11	13.69	16.63	33.45	41.83
16	Burns Ditch	117.0	296.6	1.7	11.6	7.59	18.18	1.61	4.07	5.54	13.29	14.74	35.54
17	Michigan City	32.7	82.8	–	–	2.94	4.89	0.73	1.08	1.99	2.98	5.66	8.95

Table DA-IV-C-4

ALTERNATIVE IV TREATMENT FACILITY COSTS

MAP REF NO	NAME	CAPITAL COSTS 4 ($ MILLION) TREATMENT FACILITY 1990	2020	STORAGE 1990	2020	5 ANNUAL CAPITAL COST ($ MILLION) 1990	2020	6 ANNUAL REPLACEMENT COST ($ MILLION) 1990	2020	7 O & M COST ($ MILLION) 1990	2020	8 TOTAL ANNUAL COST ($ MILLION) 1990	2020
	McHenry West	184.4	309.9	–	–	10.88	18.29	1.78	2.90	8.60	14.12	21.26	35.31
	McHenry Central	85.1	85.1	–	–	5.02	5.02	0.69	0.69	3.42	3.42	9.13	9.13
	Kendall	186.4	292.8	–	–	11.00	17.28	1.90	2.86	8.72	13.16	21.62	33.30
	Grundy-Will-Kankakee & Iroquoi	857.0	1001.6	–	–	50.57	59.10	9.04	10.40	44.64	51.41	104.25	120.91
	Newton-Jasper-Pulaski & Starke	1176.7	1374.1	–	–	69.42	81.07	12.87	14.96	58.86	68.38	141.15	164.41

Table DA-IV-C-5

ALTERNATIVE V TREATMENT FACILITY COSTS

MAP REF NO	NAME	CAPITAL COSTS 4 ($ MILLION) TREATMENT FACILITY 1990	CAPITAL COSTS 4 ($ MILLION) TREATMENT FACILITY 2020	CAPITAL COSTS 4 ($ MILLION) STORAGE 1990	CAPITAL COSTS 4 ($ MILLION) STORAGE 2020	5 ANNUAL CAPITAL COST ($ MILLION) 1990	5 ANNUAL CAPITAL COST ($ MILLION) 2020	6 ANNUAL REPLACEMENT COST ($ MILLION) 1990	6 ANNUAL REPLACEMENT COST ($ MILLION) 2020	7 O & M COST ($ MILLION) 1990	7 O & M COST ($ MILLION) 2020	8 TOTAL ANNUAL COST ($ MILLION) 1990	8 TOTAL ANNUAL COST ($ MILLION) 2020
3	North Side	614.3	721.7	–	–	36.24	42.58	11.93	13.39	38.64	42.62	86.81	98.59
4	West-Southwest	1447.2	1661.2	–	–	85.39	98.01	29.70	32.65	91.13	99.09	206.22	229.75
15	Hammond	496.0	496.0	–	–	29.26	29.26	7.14	5.42	25.32	18.42	61.72	53.10
7	Calumet	813.4	1005.0	–	–	47.99	59.29	13.77	16.42	41.25	47.68	103.01	123.39
8	Gary	263.6	339.3	0.8	1.3	15.63	20.09	4.13	5.11	13.69	16.63	33.45	41.83
	McHenry West	184.4	309.9	–	–	10.88	18.29	1.78	2.90	8.60	14.12	21.26	35.31
	McHenry Central	85.1	85.1	–	–	5.02	5.02	0.69	0.69	3.42	3.42	9.13	9.13
	Kendall	186.4	292.8	–	–	11.00	17.28	1.90	2.86	8.72	13.16	21.62	33.30
	Grundy-Will-Kankakee	203.0	343.0	–	–	11.98	20.23	2.07	3.39	10.25	16.78	24.30	40.40
	Newton-Jasper	77.7	169.6	–	–	4.59	10.01	0.66	1.47	2.91	6.47	8.16	17.95

TABLE DA-IV-C-6

UNIT CONVEYANCE COSTS

Unit Costs in Million Dollars/Sq. Mi. Area

	W/Storm-Water	W/O Storm-Water
Alternative I		
Chicago Area (375.0 sq.mi.)	2.19	2.19
Other Combined Areas (210.4 sq.mi.)	0.47	0.11
Alternative II		
Chicago Area (375.0 sq.mi.)	2.19	2.19
Total Suburban Area (885.3 sq.mi.)	0.19	0.11
Alternative III		
Chicago Area (375.0 sq.mi.)	2.19	2.19
Total Suburban Area (885.3 sq.mi.)	0.26	0.18
Alternative IV		
Chicago Area (375.0 sq. mi.)	2.19	2.19
Total Suburban Area (885.3 sq.mi.)	1.26	1.18
Alternative V		
Chicago Area (375.0 sq.mi.)	2.19	2.19
Total Suburban Area (885.3 sq.mi.)	0.82	0.74

Note: Above unit costs based on an assumption of one deep storage pit located near the sewer overflow structure, per combined sewer suburban service area.

STORMWATER MANAGEMENT SYSTEMS

The stormwater management system presents a unique case since there are three types of land-uses within the C-SEIM area; rural, suburban, and urban. The three land-use areas are delineated in Figures B-IV-D-1 and B-IV-D-2 of Appendix B.

The unit cost breakdown for stormwater management is on a sub-watershed basis. The subwatershed delineation is shown in Figure DA-IV-C-12.

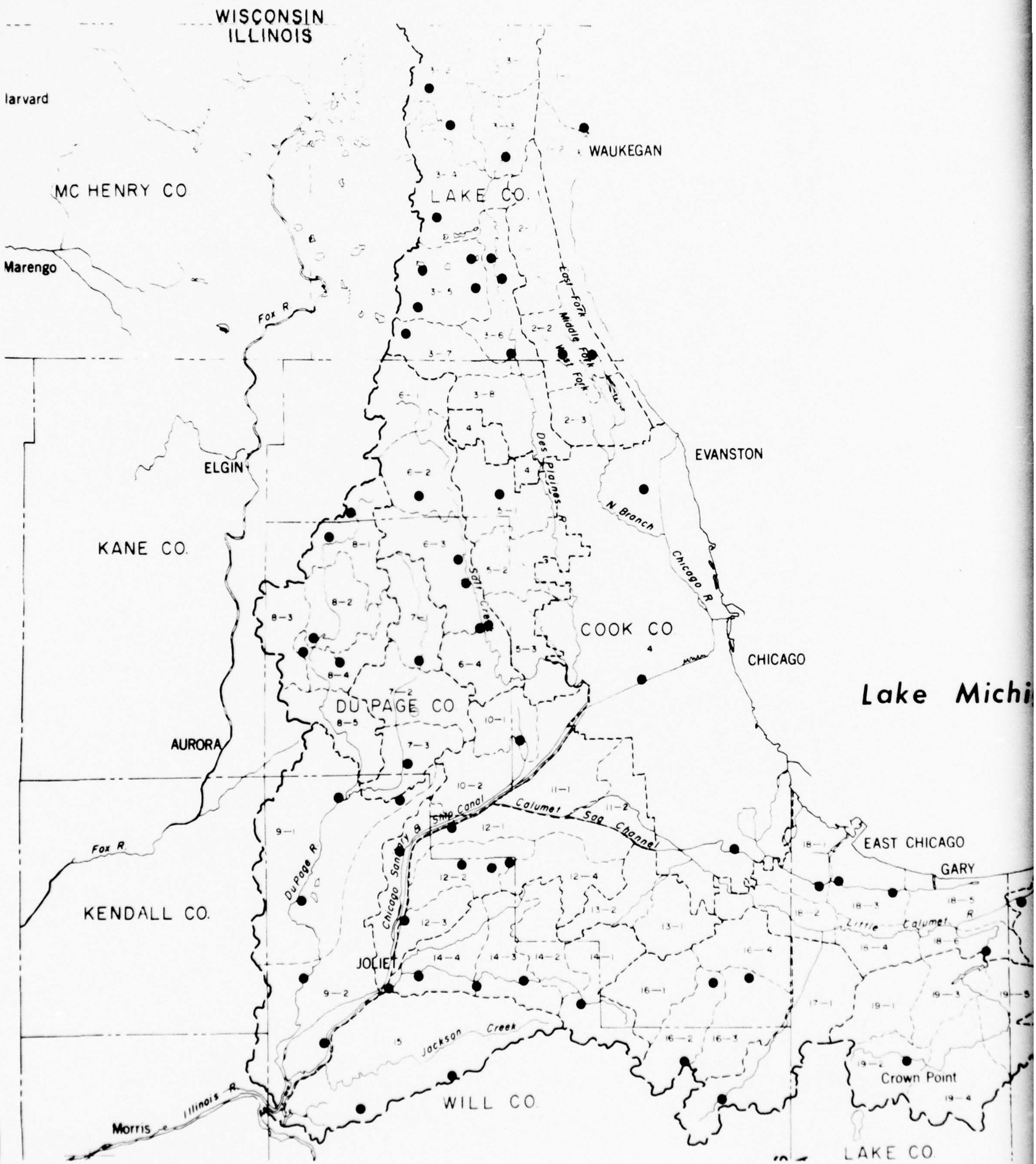
Table DA-IV-C-7 lists the unit costs for the with stormwater management option of a square mile of service area for each of the sub-watersheds shown on Figure DA-IV-C-I. Table DA-IV-C-8 presents the same information for the without stormwater situation.

Total capital costs for stormwater management can be estimated by determining the subwatershed where the cost is desired, obtaining the various unit costs from Tables DA-IV-C-7 or DA-IV-C-8, and multiplying it by the square miles of the area in question.

SLUDGE MANAGEMENT SYSTEMS

Sludge management unit costs are based on a cost per MGD of wastewater flow treated. The cost of sludge treatment can be normalized because the yield of sludge from one million gallons of wastewater flow is assumed to be constant. The following information presents the unit cost for sludge management:

Alternative	Cost $million/MGD
I	0.087
II	0.410
III	
Option 1	0.073
Option 2	0.114
IV	
Option 1	0.035
Option 2	0.069
V	
Option 1	0.063
Option 2	0.098


WISCONSIN
ILLINOIS
larvard
MC HENRY CO
Marengo
Fox R
LAKE CO.
WAUKEGAN
East Fork
Middle Fork
West Fork
Des Plaines R
EVANSTON
ELGIN
N Branch
Chicago R
KANE CO.
COOK CO
CHICAGO
Lake Michi
DU PAGE CO
AURORA
Salt Creek
Calumet Sag Channel
Chicago Sanitary & Ship Canal
EAST CHICAGO
GARY
Little Calumet R
Fox R.
Du Page R
KENDALL CO.
JOLIET
Jackson Creek
Crown Point
Illinois R.
Morris
WILL CO.
LAKE CO.

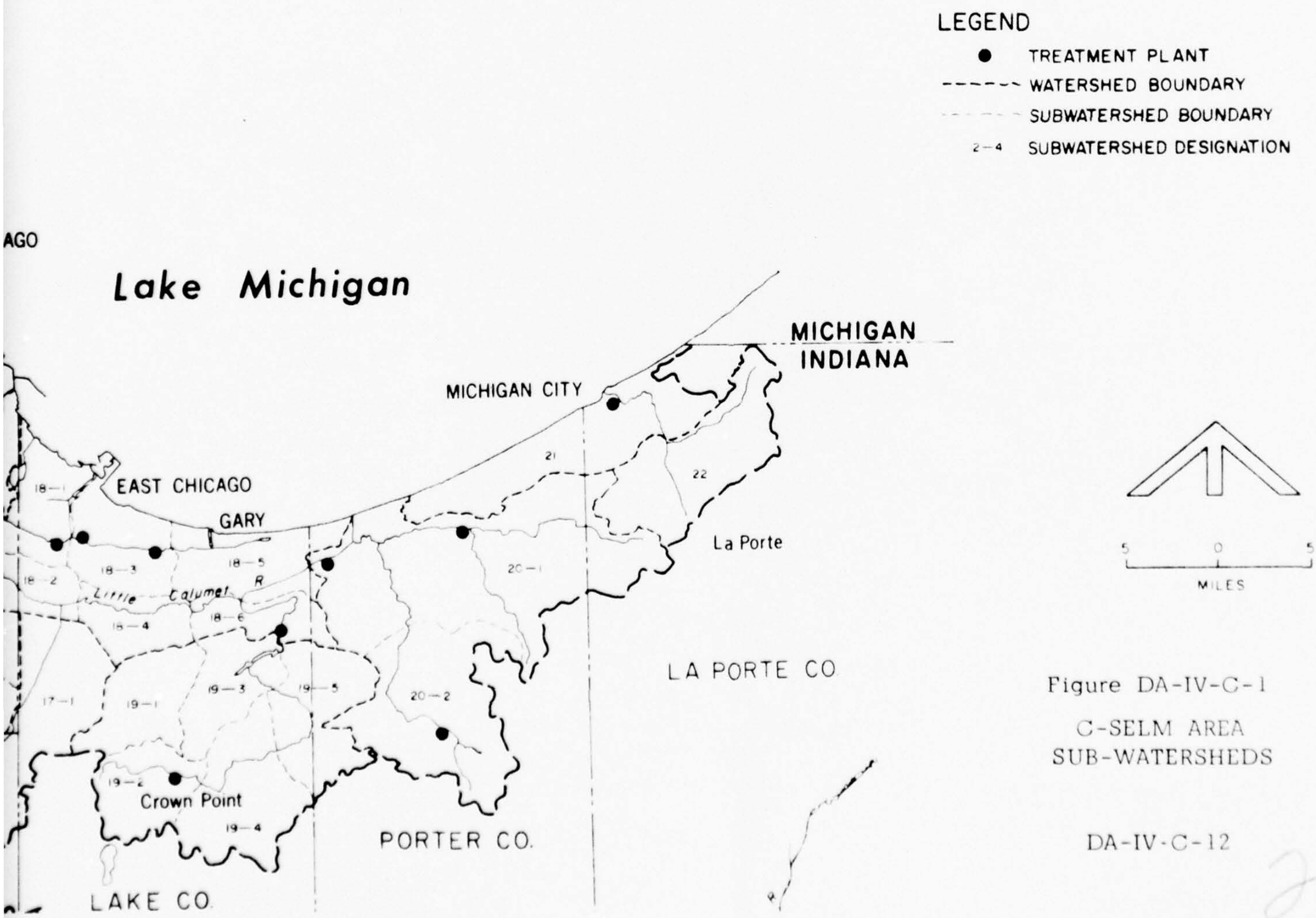


Figure DA-IV-C-1

C-SELM AREA
SUB-WATERSHEDS

TABLE DA-IV-C-7

TABULATION OF STORMWATER MANAGEMENT
COSTS PER SUB-WATERSHED, WITH STORMWATER

Watershed No.	Sub-Watershed No.	1990 Rural Area @ $ Sq.Mi.	1990 Rural Area /sq mi Cost	1970 Suburban & Urban Area @ $ Sq.Mi.	1970 Suburban & Urban Area /sq mi Cost	1970-1990 Suburban Area @ $ Sq.Mi.	1970-1990 Suburban Area /sq mi Cost
1	1-1	19.5	13.2	4.5	2.8	2.0	1.3
	1-2	1.1	.7	18.5	95.9	15.0	9.5
2	2-1	19.6	13.2	3.5	2.2	9.5	6.1
	2-2	5.1	3.4	13.0	8.2	10.1	6.5
	2-3	0.4	.3	20.5	39.3	8.4	5.3
3	3-1	26.2	17.7	-	-	-	-
	3-2	28.5	19.3	-	-	6.5	4.2
	3-3	17.3	11.7	-	-	7.6	4.9
	3-4	24.3	16.4	4.9	3.1	14.7	9.3
	3-5	30.5	20.6	3.0	1.9	4.1	2.6
	3-6	23.2	15.7	5.6	3.6	4.8	3.0
	3-7	19.1	12.9	2.6	1.6	5.0	3.1
	3-8	1.3	.9	27.4	17.3	4.3	2.8
4	-	-	-	375.0	400.1	-	-
5	5-1	5.7	3.9	18.3	11.6	7.3	4.7
	5-2	2.2	1.5	17.6	11.2	5.8	3.7
	5-3	1.1	.7	12.1	7.7	9.9	6.3
6	6-1	5.4	3.7	8.0	5.0	13.0	8.2
	6-2	23.0	15.6	2.5	1.6	3.0	1.9
	6-3	10.3	7.0	17.6	11.1	11.4	7.2
	6-4	-	-	12.1	55.0	9.7	6.1

TABLE DA-IV-C-7 (Continued)

Watershed No.	Sub-Watershed No.	1990 Rural Area @ $ Sq.Mi.	1990 Rural Area /sq mi Cost	1970 Suburban & Urban Area @ $ Sq.Mi.	1970 Suburban & Urban Area /sq mi Cost	1970-1990 Suburban Area @ $ Sq.Mi.	1970-1990 Suburban Area /sq mi Cost
7	7-1	3.9	2.6	12.8	34.4	9.4	5.9
	7-2	5.6	3.8	12.9	34.4	14.3	9.0
	7-3	8.3	5.6	4.5	2.9	10.6	6.7
8	8-1	23.1	15.6	1.2	0.8	4.0	2.5
	8-2	7.5	5.1	7.9	10.2	11.0	6.9
	8-3	8.0	5.4	0.6	0.4	12.9	8.1
	8-4	8.0	5.4	4.0	23.6	8.4	5.3
	8-5	17.6	11.9	3.0	17.7	5.8	3.6
9	9-1	104.5	70.7	-	-	-	-
	9-2	80.3	54.3	-	-	9.2	5.9
10	10-1	-	-	17.5	37.3	1.5	0.9
	10-2	-	-	19.4	12.3	15.6	9.8
	10-3	10.3	7.0	5.6	3.5	7.9	5.0
11	11-1	-	-	15.3	41.1	13.7	8.6
	11-2	6.9	4.7	16.5	10.4	-	-
12	12-1	21.4	14.5	-	-	6.6	4.3
	12-2	25.1	17.0	-	-	1.0	0.6
	12-3	9.4	6.4	-	-	4.6	2.9
	12-4	24.4	16.5	-	-	1.8	1.1
13	13-1	7.3	4.9	9.5	6.0	7.0	4.5
	13-2	8.9	6.0	1.0	0.6	7.0	4.5

TABLE DA-IV-C-7 (Continued)

Watershed No.	Sub-Watershed No.	1990 Rural Area @ $ /sq mi Sq.Mi.	Cost	1970 Suburban & Urban Area @ $ /sq mi Sq.Mi.	Cost	1970-1990 Suburban Area @ $ /sq mi Sq.Mi.	Cost
14	14-1	28.8	19.5	1.2	7.1	7.2	4.6
	14-2	16.3	11.0	1.1	7.1	6.4	4.0
	14-3	16.0	10.8	2.7	16.0	8.8	5.6
	14-4	11.2	7.6	7.0	41.3	10.1	6.5
15		106.4	72.0	-	-	4.5	2.8
16	16-1	15.4	10.4	6.3	4.1	3.9	2.5
	16-2	10.4	7.0	12.8	8.2	5.1	3.2
	16-3	15.2	10.3	11.6	7.4	5.2	3.3
	16-4	0.8	0.5	18.3	100.8	5.3	3.3
17		34.1	23.1	-	-	-	-
17-1		22.6	15.3	7.5	4.8	2.5	1.6
18	18-1	0.8	0.5	11.3	66.6	13.4	8.5
	18-2	4.5	3.0	11.3	66.6	6.3	4.0
	18-3	6.6	4.5	14.4	84.8	6.1	3.8
	18-4	11.7	7.9	5.6	33.0	-	-
	18-5	15.1	10.2	7.8	45.9	7.4	4.8
	18-6	13.8	9.3	0.9	5.3	1.0	.6
19	19-1	22.4	15.1	1.7	10.1	1.4	.9
	19-2	18.4	12.4	1.1	6.5	2.3	1.4
	19-3	17.1	11.6	1.4	6.2	3.5	2.2
	19-4	36.9	25.0	0.8	.5	1.3	.8
	19-5	33.3	22.5	-	-	-	-

TABLE DA-IV-C-7 (Continued)

Watershed No.	Sub-Watershed No.	1990 Rural Area Sq.Mi.	@ $ /sq mi Cost	1970 Suburban & Urban Area Sq.Mi.	@ $ /sq mi Cost	1970-1990 Suburban Area Sq.Mi.	@ $ /sq mi Cost
20	20-1	105.9	71.6	-	-	10.0	6.4
	20-2	54.7	37.0	-	-	5.0	3.2
21		33.6	22.7	-	-	12.5	8.0
22		43.4	29.3	-	-	3.5	2.2

Table DA-IV-C-8

COMBINED SEWER SYSTEM AREA COSTS - WITHOUT STORMWATER

Water-Shed No.	Sub-Water Shed No.	Cost Per Sub-Watershed Sq. Mi.	Cost in Millions	Water-Shed No.	Sub-Water Shed No.	Cost Per Sub-Watershed Sq. Mi.	Cost in Millions
1	1-2	11.6	68.2	12	12-3	4.0	2.5
2	2-1	.7	.4	13	13-1	1.9	1. 2
	2-2	2.7	1.7				
				14	14-4	11.0	64.6
3	3-7	.3	.14				
				17	17-1	5.5	3.5
4		375.0	400.1				
				18	18-1	59.8	37.6
					18-2	5.0	29.4
6	6-3	6.0	3.7		18-3	42.0	26.5
	6-4	4.5	2.8				
7	7-1	5.0	29.4	19	19-2	7.0	4.4
	7-2	5.0	29.4				
				20	20-1	10.8	6.7
					20-2	7.6	4.7
8	8-4	14.0	82.3				
	8-5	3.4	20.0				
10	10-1	2.6	15.3				
						585.4	434.5

The cost of any specific sludge management system would be based upon projected plant flows from the treatment facility.

REUSE SYSTEMS

Reuse system unit costs are based on a gross square mileage basis for each of the alternatives, as follows for recreational-navigational reuse:

Alternative	Reuse Cost $Million/square mile
I	no reuse
II	
w/	0.023
w/o	0.021
III	
w/	0.023
w/o	0.021
IV	
w/	0.426
w/o	0.424
V	
w/	0.254
w/o	0.252

w/ - with stormwater
w/o - without stormwater

The cost of potable reuse is given in dollars per MGD supplied and is listed as follows:

Alternative			Reuse Cost $Million/MGD
II & II			
	Option 1		
		w/	0.459
		w/o	0.231
	Option 2		
		w/	0.212
		w/o	0.212
IV & IV			
	Option 1		
		w/	0.465
		w/o	0.238
	Option 2		
		w/	0.212
		w/o	0.212

Total reuse system cost estimations can be obtained by multiplying the recreational-navigational unit cost by the number of square miles in question. Potable resue can be obtained by multiplying the unit cost by the projected deficiency.

PRESENT-WORTH MODEL

The present-worth model will use, in addition to the physical characteristics of the individual system components presented above, the present-worth costs shown in the cost tables of Section D-IV-C.

Treatment Facilities

The individual treatment facilities for each of the five alternatives have been identified in tables DA-IV-C-1 through DA-IV-C-5. In order to estimate the present-worth costs of a given plant, a simple percentage calculation is performed. The capital cost associated with the plant under consideration is determined. This cost is then divided by the

total capital-cost (calculated by adding the first year plus future year costs) obtained from the individual alternative cost table from Section D-IV-C. This yields a percentage estimate of the cost of that facility with respect to the overall treatment facility cost. This percentage is the multiplied times the total present-worth capital cost of the individual alternative cost table, to determine the estimate of the present-worth cost of the selected facility.

For example, suppose that the estimated present-worth capital cost of the O'Hare plant of Alternative I is required. A total capital cost for the year 1990 for this facility is obtained from DA-IV-C-1 (for 5% interest). This figure is $46.0 million. The total capital cost for Alternative I is obtained from Table D-IV-C-1. It equals $1,247 million. Therefore, the O'Hare facility is approximately 3.68 percent of the total facility cost. The present-worth capital cost is equal to $1011 million, obtained from Table D-IV-C-1. This leads to an estimate of the present-worth capital cost of $37.2 million for the O'Hare facility.

The same percentage figure can be used to approximate the present-worth cost associated with the replacement cost. For example, in the case of the O'Hare plant for Alternative I, the replacement cost equals 3.68 percent of present worth capital cost of $234 million, or $8.31 million.

Operation and Maintenance present-worth costs are estimated by determining the percentage of total O & M costs associated with any selected plant from Tables DA-IV-C-1 through DA-IV-C-5. This percentage is then multiplied by the present-worth O & M cost from the individual alternative cost tables in Section D-IV-C. For example, again using the O'Hare plant, the percentage O & M cost for the facility is $2.27 million. This is 2.18 percent. This percentage times the present-worth O & M of $287 provides an estimate of $6.26 million for the O'Hare facility.

The sum of the three calculations gives the total present-worth cost associated with the O'Hare facility.

Conveyance System

Present-worth costs for any given service area for the conveyance component is estimated as a simple percentage. The specific service area is determined and the total capital cost is approximated as presented above, using Table DA-IV-C-6. Present-worth costs are then estimated by obtaining the percentage that the area selected is of the total capital cost and multiplying this by the present-worth costs shown in the individual alternative cost tables at Section D-IV-C.

This percentage estimation can be used for each of the three present-worth cost units, capital, replacement and O & M.

Stormwater Management Systems

Capital costs for the stormwater management units needed are determined in the same manner as presented above on page DA-IV-C-11. This capital cost is then divided by the total capital expenditure for stormwater management given in the individual alternative cost table of Section D-IV-C. This percentage is then used to provide an approximation of the three present-worth cost items of capital, replacement and & M, by multiplying by the total costs associated with the stormwater management system for the specific alternative in question.

Sludge Management Systems

Sludge management costs are based on a cost per MGD of wastewater flow treated. The capital cost to treat a given flow is estimated using the method presented above, on page D-IV-C-11. This figure is then used to determine the percentage of total capital cost associated with the flow in question by dividing by the total capital cost given in the individual alternative cost curves for the alternative in question. This percentage is then applied to the three present-worth cost items; capital, replacement, and O & M, to provide these approximations.

Reuse Systems

Recreational-navigational. The recreational-navigational reuse system costs are based on gross squaremileage for the area in question. The area in question is used to determine the capital costs by using the method presented on page DA-IV-C-18. This capital cost approximation is then used to estimate the percentage of capital cost associated with the area in question for the alternative under consideration. This is done by dividing the capital cost for the area by the total capital cost from the individual alternative cost tables of Section D-IV-C. This simple percentage is then used to estimate the present-worth costs for capital, replacement and operation and maintenance costs, by multiplying it by the total present-worth costs for these items obtained from the same individual alternative cost tables.

Potable. Potable reuse costs are obtained in exactly the same manner used for recreational-navigational costs. However, in these cost estimates the present-worth base costs are obtained from Table D-IV-C-33.

Table DA-IV-C-9
BASE UNITS AND COSTS
REUSE, CONVEYANCE, AND STORMWATER MANA
(costs in thousands of dollars; units

Item	Units	Alternatives										
		Alternative I				Alternative II				Alternative III		
		w[a]		w/o[b]		w		w/o		w		w/
		Unit	Cost	Units	Cost	Units	Cost	Units	Cost	Units	Cost	Units
REUSE												
Lines	L.F.	-	-	-	-	1,205	27,256	1,205	27,256	1,131	26,913	1,131
Pumping Sta.	EA	-	-	-	-	26	13,920	26	13,920	22	13,468	22
Reuse Tunnels	L.F.	-	-	-	-	-	-	-	-	-	-	-
Reuse Lines	L.F.	-	-	-	-	-	-	-	-	-	-	-
Reuse P.S.	EA	-	-	-	-	-	-	-	-	-	-	-
Contingencies	-	-	-	-	-	-	19,824	-	14,824	-	18,619	-
Total Cost	-	-	-	-	-	-	61,000	-	56,000	-	59,000	-
CONVEYANCE												
Lines	L.F.	-	-	370	11,000	3,721	110,650	2,546	75,680	3,673	145,221	2,793
Pumping Sta.	EA	-	-	10	44,100	191	95,857	152	75,717	180	99,850	144
Tunnels, Chgo.	L.F.	-	-	634	660,200	634	660,200	634	660,200	634	660,200	634
LAND: Lines	L.F.	-	-	-	-	-	-	-	-	-	-	-
Pumping Sta.	EA	-	-	-	-	-	-	-	-	-	-	-
Tunnels	L.F.	-	-	-	-	-	-	-	-	-	-	-
Pumping Sta.	EA	-	-	-	-	-	-	-	-	-	-	-
Contingencies	-	-	-	-	130,700	-	128,293	-	108,403	-	149,729	-
Total Cost	-	-	-	-	846,000	-	995,000	-	920,000	-	1055,000	-
STORMWATER												
Chgo. Underflow												
Plan Storage	Ac.Ft.	-	-	58,800	350,000	58,800	350,000	58,800	350,000	58,800	350,000	58,800
Contingencies	-	-	-	-	50,100	-	50,100	-	50,100	-	50,100	-
Urban-Suburban												
Storage	Ac.Ft.	-	-	28,013	314,823	126,406	952,165	28,013	314,823	126,406	952,165	28,013
Contingencies	-	-	-	-	119,077	-	361,822	-	119,077	-	361,822	-
Rural Storm Mg't.												
Storage	Ac.Ft.	-	-	-	-	178,627	454,002	-	-	178,627	454,002	-
Collection	Miles	-	-	-	-	234,500	32,355	-	-	234,500	32,355	-
Treatment	Acres	-	-	-	-	102,889	107,995	-	-	102,889	107,995	-
Contingencies	-	-	-	-	-	-	225,561	-	-	-	225,561	-
Total Cost	-	-	-	-	834,000	-	2534,000	-	834,000	-	2534,000	-

[a]with stormwater
[b]without stormwater

Table DA-IV-C-9
BASE UNITS AND COSTS
ICE, AND STORMWATER MANAGEMENT SYSTEMS
in thousands of dollars; units in thousands)

Alternatives											
Alternative III				Alternative IV				Alternative V			
w		w/o		w		w/o		w		w/o	
Units	Cost	Units	Cost	Units	Cost	Units	Cost	Units	Cost	Units	Cost
1,131	26,913	1,131	26,913	1,131	26,913	1,131	26,913	1,131	26,913	1,131	26,913
22	13,468	22	13,468	22	13,468	22	13,468	22	13,468	22	13,468
-	-	-	-	1,148	552,200	1,148	552,200	1,090	262,050	1,090	262,050
-	-	-	-	610	53,820	610	53,820	658	121,670	658	121,670
-	-	-	-	23	153,250	23	153,250	17	51,750	17	51,750
-	18,619	-	14,619	-	307,400	-	303,400	-	185,200	-	180,200
-	59,000	-	55,000	-	1107,000	-	1103,000	-	661,000	-	656,000
3,673	145,221	2,793	110,251	3,673	145,221	2,793	110,251	3,673	145,221	2,793	110,251
180	99,850	144	79,710	180	99,850	144	79,710	180	99,850	144	79,710
634	660,200	634	660,200	634	660,200	634	660,200	634	660,200	634	660,200
-	-	-	-	413	36,110	413	36,110	608	57,710	608	57,710
-	-	-	-	10	4,786	10	4,786	10	5,784	10	5,784
-	-	-	-	1,539	602,320	1,539	602,320	1,115	296,170	1,115	296,170
-	-	-	-	-	-	-	-	-	-	-	-
-	149,729	-	-	-	393,513	-	372,623	-	286,065	-	265,175
-	1055,000	-	979,000	-	1942,000	-	1866,000	-	1551,000	-	1475,000
58,800	350,000	58,800	350,000	58,800	350,000	58,800	350,000	58,800	350,000	58,800	350,000
-	50,100	-	50,100	-	50,100	-	50,100	-	50,100	-	50,100
126,406	952,165	28,013	314,823	129,546	983,565	31,153	346,233	129,546	983,565	31,153	346,223
-	361,822	-	119,007	-	378,422	-	136,677	-	378,422	-	136,677
178,627	454,002	-	-	178,627	454,002	-	-	178,627	454,002	-	-
234,500	32,355	-	-	234,500	32,355	-	-	234,500	32,355	-	-
102,889	107,995	-	-	102,889	107,995	-	-	102,889	107,995	-	-
-	225,561	-	-	-	225,561	-	-	-	225,561	-	-
-	2534,000	-	834,000	-	2582,000	-	883,000	-	2582,000	-	883,000

Table DA-IV-C-10
BASE UNITS AND COSTS
POTABLE WATER
(costs in thousands of dollars; units in

Item	Units	Alternatives											
		Alternative I				Alternative II				Alternative III			
		w[a]		w/o[b]		w		w/o		w		w/o	
		Unit	Cost	Unit	Cost	Unit	Cost	Unit	Cost	Unit	Cost	Unit	Co
OPTION 1													
Pumping Sta.	EA	-	-	-	-	50	25,722	50	25,722	50	25,722	50	25,
Lines	L.F.	-	-	-	-	1,555	65,657	1,555	65,657	1,555	65,657	1,555	65,
Injection Wells	EA					285	101,062	-	-	285	101,067	-	
Transfer Lines	L.F.					65	3,400	-	-	65	3,400	-	
Contingencies						-	70,159	-	42,621	-	70,159	-	42,
Total		-	-	-	-	-	266,000	-	134,000	-	266,000	-	134,
OPTION 2													
Pumping Sta.	EA	-	-	-	-	10	14,960	10	14,960	10	14,960	10	14,
Lines	L.F.	-	-	-	-	1,641	74,179	1,641	74,179	1,641	74,179	1,641	74,
Contingencies						-	33,861	-	33,861	-	33,861	-	33,
Total						-	123,000	-	123,000	-	123,000	-	123,

[a]with stormwater
[b]without stormwater

Table DA-IV-C-10
BASE UNITS AND COSTS
POTABLE WATER
sts in thousands of dollars; units in thousands)

	Alternatives											
	Alternative III				Alternative IV				Alternative V			
	w		w/o		w		w/o		w		w/o	
st	Unit	Cost	Unit	Cost	Unit	Cost	Unit	Cost	Unit	Cost	Unit	Cost
722	50	25,722	50	25,722	50	27,817	50	27,817	50	27,817	50	27,817
657	1,555	65,657	1,555	65,657	1,555	66,208	1,555	66,208	1,555	66,208	1,555	66,208
-	285	101,067	-	-	285	101,062	-	-	285	101,062	-	-
-	65	3,400	-	-	65	3,400	-	-	65	3,400	-	-
621	-	70,159	-	42,621	-	70,513	-	43,975	-	70,513	-	43,975
000	-	266,000	-	134,000	-	269,000	-	138,000	-	269,000	-	138,000
960	10	14.960	10	14,960	10	14,960	10	14,960	10	14,960	10	14,960
179	1,641	74,179	1,641	74,179	1,641	74,179	1,641	74,179	1,641	74,179	1,641	74,179
861	-	33,861	-	33,861	-	33,861	-	33,861	-	33,861	-	33,861
000	-	123,000	-	123,000	-	123,000	-	123,000	-	123,000	-	123,000

Table DA-IV-C-11
BASE UNITS AND COSTS
SLUDGE DRAINAGE SYSTEM
(costs in thousands of dollars; units in tho

Item	Units	Alternatives									
		Alternative I				Alternative II				Alternati	
		w[a]		w/o[b]		w		w/o		w	
		Units	Cost	Units	Cost	Units	Cost	Units	Cost	Units	Cost
OPTION 1, Agric.											
Pipeline System	L.F.	-	-	4,128	145,100	1,998	62,000	1,998	62,000	1,536	73,000
Land Application System	Acres	-	-	52	30,300	590	265,652	590	265,652	52	36,500
Land Aquisition	Acres	-	-	17	14,600	649	564,637	649	564,637	57	49,202
Contingencies	-	-	-	-	72,200	-	338,711	-	338,711	-	60,298
Total	-	-	-	-	262,200	-	1231,000	-	1231,000	-	219,000
OPTION 2, Land											
Pipeline System	L.F.	-	-	-	-	-	-	-	-	2,462	173,326
Land Application System	Acres	-	-	-	-	-	-	-	-	72	75,072
Land Aquisition	Acres	-	-	-	-	-	-	-	-	-	-
Contingencies	-	-	-	-	-	-	-	-	-	-	94,602
Total	-	-	-	-	-	-	-	-	-	-	343,000

[a]with stormwater
[b]without stormwater

Table DA-IV-C-11
BASE UNITS AND COSTS
LUDGE DRAINAGE SYSTEM
sands of dollars; units in thousands)

Alternatives												
	Alternative III				Alternative IV				Alternative V			
	w		w/o		w		w/o		w		w/o	
Cost	Units	Cost	Units	Cost	Units	Cost	Units	Cost	Units	Cost	Units	Cost
62,000	1,536	73,000	1,536	73,000	195	10,224	195	10,224	662	54,217	662	54,217
265,652	52	36,500	52	36,500	52	30,217	52	30,217	52	35,159	52	35,153
564,637	57	49,202	57	49,202	57	36,666	57	36,666	57	46,123	57	46,123
338,711	-	60,298	-	60,298	-	28,893	-	28,893	-	52,501	-	52,501
231,000	-	219,000	-	219,000	-	106,000	-	106,000	-	188,000	-	188,000
-	2,462	173,326	2,462	173,326	1,542	89,681	1,542	89,681	2,189	142,253	2,189	142,253
-	72	75,072	72	75,072	66	59,710	66	59,710	71	69,420	71	69,420
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	94,602	-	94,602	-	56,609	-	56,609	-	82,327	-	82,327
-	-	343,000	-	343,000	-	206,000	-	206,000	-	294,000	-	294,000

DATA ANNEX D

V. COMPARISON OF REGIONAL
WASTEWATER MANAGEMENT ALTERNATIVES

V. COMPARISON OF REGIONAL WASTEWATER MANAGEMENT ALTERNATIVES

B. WATER RESOURCE

PURPOSE

The purpose of this section is the presentation of the stream flow summary tables referenced in Appendix D, Section V-B. Tables DA-V-B-1 through DA-V-B-4 present the flow summary for each of Alternatives II through V, respectively.

The tables should be used in conjunction with the detailed map showing recreational flow injection points and other reference points. This map appears as Figure B-IV-G-4 in Appendix B, Section IV-G, page B-IV-G-15. In addition, each of the reference points is listed in Table B-IV-G-2, pages B-IV-G-16 through B-IV-G-18, of Appendix B, Section IV-G, which presents minimum and maximum flow associated with the reference points.

ORGANIZATION

Column 1 of each table lists the reference points discussed above. The reference points play an important role in the organization of the table. Key reference points are located along the major streams of the C-SELM area. Flow upstream of these reference points is summed to that point, and then compared with the minimum and maximum flows in the stream as given in columns 24 and 25.

Columns 2 through 19 quantify the pertinent flows upstream of the given reference point. The accumulated flows are then reported in columns 20-23 for summer and winter conditions for 1990 and 2020 on an average daily basis.

Columns 26 and 27 present data for the maximum wet flow conditions associated with summer flows 2020. Column 26 is the difference between the treatment system capacity and the average daily flow for all reference points with treatment plants upstream of the reference point. This condition produces the maximum flow conditions. These incremental increases are added to column 23 and placed in column 27.

The tables for Alternative IV reflect no entries for columns 26 and 27. This is because all flows are returned from the land sites at a constant rate, with no variation except the summer and winter differential which is already identified.

Figure DA-V-B-1 ALTERNATIVE II FL

REFERENCE NUMBER	RURAL CONTRIBUTION 1990		RURAL FLOW DECREASE 1990 TO 2020 MGD	NAVAGATIONAL AND/OR RECREATIONAL TRANSFERS (1990 ONLY)		TRANSFER FLOW SOURCE (1990)		FLOW UPSTREAM FROM LAST REFERENCE NUMBER							
								1990				2020			
	SUMMER MGD	WINTER MGD		SUMMER MGD	WINTER MGD	PLANT NUMBER	PLANT FLOW	SUMMER MGD	REFERENCE NUMBER	WINTER MGD	REFERENCE NUMBER	SUMMER MGD	REFERENCE NUMBER	WINTER MGD	REFERENCE NUMBER
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	89.3	0	0	35.6	35.6	9 20	8.3 27.3 35.6								
2	85.5	0	30.1					124.9 17.3 8.4 150.6	1 33 34	35.6 8.7 5.0 49.3	1 33 34	124.9 17.3 8.4 150.6	1 33 34	35.6 8.7 5.0 49.3	1 33 34
3	0	0	0	5.7	5.7	10	5.7								
4	2.1	0	2.1	3.6	3.6	10	3.6								
5	55.7	0	24.5					236.1 4.4 8.0 5.7 5.7 259.9	2 35 36 3 4	49.3 3.0 4.8 5.7 3.6 66.4	2 35 36 3 4	230.5 4.4 8.0 5.7 3.6 252.2	2 35 36 3 4	73.8 3.0 4.8 5.7 3.6 90.9	2 35 36 3 4
6	4.4	0	4.4	3.4	3.4	10	3.4								
7	4.8	0	1.2	5.0	5.0	9 24 30	0.1 1.9 3.0 5.0								
8	4.8	0	1.2	11.8	11.8	30	11.8								
9	8.6	0	3.4	11.8	11.8	29 30	8.8 3.0 11.8								
10	0	0	0	100***	100***	DES PLAINES RIVER TRANSFER NO. 1		9.8 16.6 20.4 46.8	7 8 9	5.0 11.8 11.8 28.6	7 8 9	8.6 15.4 17.0 41.0	7 8 9	5.0 11.8 11.8 28.6	7 8 9
11	2.0	0	2.0	10.4	10.4	2	10.4								
12	25.9	0	6.5					12.4	11	10.4	11	10.4	11	10.4	11
13	0	0	0	6.3	6.3	34 35	6.3								
14	0	0	0	6.3	6.3	2	6.3								
15	2.9	0	1.7	20.1	20.1	35 36 37	5.5 14.6 20.1	6.3	14	6.3	14	6.3	14	6.3	14
16	4.0	0	4.0					29.3	15	26.4	15	27.6	15	26.4	15
17	0	0	0	7.7	7.7	2	7.7								
18	22.0	0	12.9					7.7	17	7.7	17	7.7	17	7.7	17
19	24.2	0	13.3	34.5	34.5	12 5 37 41	7.5 11.9 4.9 10.2 34.5	29.7	18	7.7	18	16.8	18	7.7	18

V-B-1 ALTERNATIVE II FLOW SUMMARY

SHEET / OF 2

…M LAST REFERENCE NUMBER					RESIDUAL PLANT			ACCUMULATED FLOW IN STREAMS				MAXIMUM ALLOWABLE FLOW @ 1.8 fps	MINIMUM FLOW	2020 WET FLOW INCREMENT	2020 ACUM WET FLOW (MAX FLOW)
	2 0 2 0				INJECTIONS			1 9 9 0		2 0 2 0					
…NCE …ER	SUMMER MGD 13	REFERENCE NUMBER 14	WINTER MGD 15	REFERENCE NUMBER 16	1990 MGD 17	2020 MGD 18	PLANT NUMBER 19	SUMMER MGD 20	WINTER MGD 21	SUMMER MGD 22	WINTER MGD 23	24	25	26	27
								124.9	35.6	124.9	35.6	235.0	4.0	—	—
	124.9 17.3 8.4 150.6	1 33 34	35.6 8.7 5.0 49.3	1 33 34	0	15.0 9.5 24.5	9 20	236.1	49.3	230.5	73.8	340.0	6.0	34.0	264.5
								5.7	5.7	5.7	5.7	38.0	2.0	—	—
								5.7	3.6	3.6	3.6	24.0	2.0	—	—
	230.5 4.4 8.0 5.7 3.6 252.2	2 35 36 3 4	73.8 3.0 4.8 5.7 3.6 90.9	2 35 36 3 4	0 0 49.0 49.0	12.5 17.7 67.1 97.3	24 29 10	364.6	115.4	380.7	188.2	500.0	20.0	160.4	541.1
								7.8	3.4	3.4	3.4	23.0	2.0	—	—
								9.8	5.0	8.6	5.0	15.0	3.0	—	—
								16.6	11.8	15.4	11.8	23.0	2.0	—	—
								20.4	11.8	17.0	11.8	23.0	2.0	—	—
7 8 9	8.6 15.4 17.0 41.0	7 8 9	5.0 11.8 11.8 28.6	7 8 9	0	0	30	46.8	28.6	41.0	28.6	210.0	3.0	—	—
								12.4	10.4	10.4	10.4	65.0	2.0	—	—
11	10.4	11	10.4	11	24.2 16.6 4.2 45.0	28.8 28.0 7.1 63.9	2 33 34 35	83.3	55.4	93.7	74.3	223.0	12.0	140.7	234.4
								6.3	6.3	6.3	6.3	42.0	2.0	—	—
								6.3	6.3	6.3	6.3	25.0	3.0	—	—
4	6.3	14	6.3	14				29.3	26.4	27.6	26.4	44.0	7.0	—	—
5	27.6	15	26.4	15	0	10.8 3.9 14.7	37 41	33.3	26.4	42.3	41.1	165.0	9.0	46.6	[illegible]
								7.7	7.7	7.7	7.7	51.0	3.0	—	—
7	7.7	17	7.7	17				29.7	7.7	16.8	7.7	109.0	7.0	—	—
8	16.8	18	7.7	18	10.1 10.7 20.8	16.2 28.7 44.9	38 39	109.2	63.0	101.7	87.1	230.0	9.0	47.5	149.2

Figure DA-V-B-1 ALTERNATIVE II F

REFERENCE NUMBER	RURAL CONTRIBUTION 1990		RURAL FLOW DECREASE 1990 TO 2020 MGD	NAVAGATIONAL AND/OR RECREATIONAL TRANSFERS (1990 ONLY)		TRANSFER FLOW SOURCE (1990)		FLOW UPSTREAM FROM LAST REFERENCE NUMBER							
								1990				2020			
	SUMMER MGD	WINTER MGD		SUMMER MGD	WINTER MGD	PLANT NUMBER	PLANT FLOW	SUMMER MGD	REFERENCE NUMBER	WINTER MGD	REFERENCE NUMBER	SUMMER MGD	REFERENCE NUMBER	WINTER MGD	REFERENCE NUMBER
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
20	0	0	0	7.4	7.4	[illegible]	[illegible]								
21	[illegible]	0	15.9	—				[illegible] [illegible] 7.4 149.[illegible]	16 19 20	[illegible] 65.[illegible] [illegible] [illegible]	16 19 20	[illegible] 10[illegible] 7.4 156.[illegible]	16 19 [illegible]	41.[illegible] [illegible] 7.4 155.[illegible]	16 19 20
22	3.6	0	0	5.1	5.1	53	5.1								
23	1.4	0	1.4	6.0	6.0	53	6.0								
24	15.6	0	13.4					7.4	40	6.[illegible]	40	[illegible]	40	[illegible]	40
25	11.1	0	10.9	13.1	13.1	14 51	6.1 7.0 13.1								
26	0	0	0	[illegible]	9.5	AL SAG CHANNEL TRANSFER		—							
27	3.5	0	3.5	4.1	4.1	AL SAG CHANNEL TRANSFER									
28	13.8	0	5.6	11.3	11.3	14	11.3								
29	11.5	0	0	10.5	10.5	8	10.5								
30	39.9	0	3.2	18.0	18.0	8	10.5	—							
31	2.2	0	0	5.1	5.1	16	5.1	—	—		—				
32	55.8	0	7.0	40.0	40.0	8	40.0	8.7 20.0 28.7	22 47A	5.1 20.0 25.1	22 47A	[illegible]	[illegible] 47A	[illegible]	[illegible]
33	8.6	0	0	8.7	8.7	9	8.7								
34	3.4	0	0	5.0	5.0	24	5.0								
35	1.4	0	0	3.0	3.0	24	3.0			—					
36	3.2	0	0	4.8	4.8	29	4.8	—							
37	0	0	0	5.0	5.0	CAL SAG CHANNEL TRANSFER		—	—	—					
38	5.0	0	0	6.3	6.3	14 53	1.1 5.2 6.3		—			—	—		—
39	0	0	0	5.0	5.0	LAKE MICHIGAN TRANSFER		—	—		—	—			
40	1.4	0	1.4	6.0	6.0	59	6.0	—	—		—		—		—
41	0	0	0	20.0	20.0	3	20.0	—	—	—	—	—	—	—	—
42	0	0	0	75.0	75.0	7	75.0	—	—	—	—	—	—	—	—
43	55.4	0	6.4	—	—	—	—	—	—	—	—	—	—	—	—

-V-B-1 ALTERNATIVE II FLOW SUMMARY

SHEET OF 3

…CE …ER	LAST REFERENCE NUMBER 2020 SUMMER MGD 13	REFERENCE NUMBER 14	WINTER MGD 15	REFERENCE NUMBER 16	RESIDUAL PLANT INJECTIONS 1990 MGD 17	2020 MGD 18	PLANT NUMBER 19	ACCUMULATED FLOW IN STREAMS 1990 SUMMER MGD 20	WINTER MGD 21	2020 SUMMER MGD 22	WINTER MGD 23	MAXIMUM ALLOWABLE FLOW @ 1.8 fps 24	MINIMUM FLOW 25	2020 WET FLOW INCREMENT 26	2020 ACUM WET FLOW (MAX FLOW) 27
								[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			
	[illegible] 10[illegible] 7.[illegible] 156.[illegible]	16 13 [illegible]	41.[illegible] [illegible] 7.4 155.[illegible]	16 12 20	[illegible] 0 [illegible] [illegible]	[illegible] [illegible] [illegible]	[illegible]	[illegible]	[illegible]	200.9	179.3	[illegible]	[illegible]	[illegible]	[illegible]
								[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.0	—	—
								[illegible]	[illegible]	6.0	[illegible]	[illegible]	2.0	—	—
	[illegible]	40	[illegible]	40	[illegible]	[illegible]	14	[illegible]	14.5	[illegible]	23.7	[illegible]	4.0	[illegible]	[illegible]
								[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.0	—	—
									[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	—
							—		4.1	4.1	[illegible]	27.0	2.0	—	—
								[illegible]	[illegible]	[illegible]	11.9	[illegible]	[illegible]	—	—
								[illegible]	[illegible]	[illegible]	10.5	[illegible]	2.0	—	—
								[illegible]	[illegible]	54.7	18.0	[illegible]	[illegible]	—	—
—								[illegible]	[illegible]	7.3	[illegible]	[illegible]	[illegible]	—	—
2 7A	[illegible]	[illegible] 4[illegible]A	[illegible] 25.[illegible]	[illegible]		—		[illegible]4.5	65.1	117.5	65.1	[illegible]	[illegible]	—	—
								17.3	[illegible]	17.3	8.7	[illegible]	2.0	—	—
						—	—	[illegible]	[illegible]	[illegible]	5.0	[illegible]	2.0	—	—
								4.1	[illegible]	4.4	3.0	[illegible]	2.0	—	—
								[illegible]	4.3	8.0	4.9	[illegible]	2.0	—	—
								5.[illegible]	[illegible]	5.0	5.0	[illegible]	4.0	—	—
	—	—	—	—	—	—	—	11.[illegible]	6.5	11.[illegible]	[illegible]	[illegible]	3.0	—	—
—					—	—		5.0	5.0	5.0	5.0	[illegible]	[illegible]	[illegible]	[illegible]
—		—		—				7.4	6.0	6.0	6.0	[illegible]	[illegible]	—	
—	—	—		—	—	—	—	[illegible]	[illegible]	[illegible]	20.0	—		—	—
—	—		—	—	—	—	—	[illegible]	[illegible]	[illegible]	75.0			—	—
—	—	—	—	—	10.1	17.8	17	65.5	10.1	66.8	17.8	[illegible]		23.2	[illegible]

Figure DA-V-B-1 ALTERNATIVE II FLOW SU

REFERENCE NUMBER	RURAL CONTRIBUTION 1990		RURAL FLOW DECREASE 1990 TO 2020 MGD	NAVIGATIONAL AND/OR RECREATIONAL TRANSFERS (1990 ONLY)		TRANSFER FLOW SOURCE (1990)		FLOW UPSTREAM FROM LAST REFERENCE NUMBER								RESIDU	
								1990				2020				INJE	
	SUMMER MGD 2	WINTER MGD 3	4	SUMMER MGD 5	WINTER MGD 6	PLANT NUMBER 7	PLANT FLOW 8	SUMMER MGD 9	REFERENCE NUMBER 10	WINTER MGD 11	REFERENCE NUMBER 12	SUMMER MGD 13	REFERENCE NUMBER 14	WINTER MGD 15	REFERENCE NUMBER 16	1990 MGD 17	2
44	0	0	0	10.0	15.0	15	15.0										
45	0	0	0	35.0	35.0	NORTH	BRANCH	—	—			—					
46	159.0	0	38.5	—	—	—	—	22.0 57.9 7.3 124.5 211.7	29 30 31 32	10.5 18.0 5.1 65.1 98.7	29 30 31 32	22.0 54.[illegible] 7.3 117.5 201.5	29 30 31 32	10.5 18.0 5.1 65.1 98.7	29 30 31 32	[illegible]	[illegible]
47A	0	0	0	20.0	20.0	15	[illegible]	—	—	—							
47B	0	0	0	20.0	[illegible]	15	[illegible]	—	—								
48	14.5	0	3.0	—	—	—	—	— 10.0	39 44	— [illegible]	39 44	— [illegible]	39 44	— 10.0	39 44	[illegible]	[illegible]
49	0	0	0	—	—	—	—	364.6 7.4 83.3 6.3 4[illegible]	5 6 12 13	115.4 3.4 55.4 6.3 180.5	5 6 12 13	380.7 3.4 93.7 6.3 484.1	[illegible]	188.[illegible] 3.4 74.3 6.3 272.2	5 [illegible]		
50	46.7	0	18.3	—	—	—	—	7.4 31.5 24.2 — — 75.0 20.0 161.6	23 24 25 26 27 42 47B	6.0 14.5 13.1 — — 75.0 20.0 128.6	23 24 25 26 27 42 47B	6.[illegible] 31.9 1[illegible] — — 75.0 20.0 146.[illegible]	23 24 25 26 27 42 47B	6.0 24.7 13.1 — — 75.0 20.0 143.8	23 24 25 26 27 42 47B	[illegible]	[illegible]
51	18.1	0	6.9	25.0*	25.0*	DUPAGE TRANSFER NUMBER 1		642.2 1261.5 1903.7	50 53	562.5 1243.3 1805.8	50 53	623.7 1371.0 1994.7	50 53	592.[illegible] 1358.[illegible] 1951.[illegible]	50 53		
52	177.2	0	44.5	—	—	—	—	242.2 25.1 5.0 11.3 462.0 1921.8 2667.4	21 28 37 38 49 51	103.4 11.3 5.0 6.3 180.5 1805.8 2112.3	21 28 37 38 49 57	266.9 19.5 5.0 11.3 484.1 2005.9 2792.7	21 28 37 38 49 57	178.9 11.3 5.0 6.3 272.3 1951.5 2425.[illegible]	21 28 37 38 49 57	43.[illegible] 15.1 12.[illegible] 17.9 5 [illegible]	
53	0	0	0	100***	100***	DES PLAINES TRANSFER NO. 2		46.8 20.0 66.8	10 41	28.6 20.0 48.6	10 41	41.0 20.0 61.0	10 41	28.6 20.0 48.6	10 41	[illegible] [illegible] 1134.[illegible]	3[illegible] 3[illegible] 13[illegible]

e DA-V-B-1 ALTERNATIVE II FLOW SUMMARY

EAM FROM LAST REFERENCE NUMBER					RESIDUAL PLANT			ACCUMULATED FLOW IN STREAMS				MAXIMUM ALLOWABLE FLOW @ 1 8 fps	MINIMUM FLOW	2020 WET FLOW INCREMENT	2020 ACUM WET FLOW (MAX FLOW)
0	2 0 2 0				INJECTIONS			1 9 9 0		2 0 2 0					
REFERENCE NUMBER 12	SUMMER MGD 13	REFERENCE NUMBER 14	WINTER MGD 15	REFERENCE NUMBER 16	1990 MGD 17	2020 MGD 18	PLANT NUMBER 19	SUMMER MGD 20	WINTER MGD 21	SUMMER MGD 22	WINTER MGD 23	24	25	26	27
								[illegible]	[illegible]	10.0	10.0			—	—
	—							[illegible]	35.0	35.0	35.0			—	—
[illegible] 30 31 [illegible]	[illegible] [illegible] 7.3 [illegible] 201.5	[illegible]	10.5 19.0 5.1 65.1 33.7	[illegible] 30 31 [illegible]	[illegible]	[illegible] [illegible] [illegible] 143.6	16 [illegible] [illegible]	[illegible]	[illegible]	462.[illegible]	[illegible]			[illegible]	[illegible]
												—	[illegible]	—	—
							—						[illegible]	—	—
39 44	— [illegible]	[illegible] 44	— [illegible]	[illegible] 14	[illegible]	[illegible]	6	[illegible]	131.2	95.3	54.4	—	—	—	—
5 6 12 13	[illegible] 3.4 93.7 6.4 484.1	[illegible]	[illegible] 3.4 74.3 6.3 272.2	[illegible]			—	[illegible]	[illegible]	484.1	272.2	—	—	301.1	743.1
23 24 25 26 27 42 47B	[illegible] 31.9 [illegible] — — 75.0 20.0 146.2	[illegible] [illegible] [illegible] [illegible] 27 42 47B	4.0 [illegible] 13.1 — — 75.0 20.0 143.8	[illegible] [illegible] [illegible] [illegible] 27 42 47B	[illegible]	[illegible] [illegible] 4.3 [illegible]	7 15 53	647.2 -5.0 642.2	567.5 -5.0 562.5	628.7 -5.0 623.7	597.9 -5.0 592.9	—	—	265.7	[illegible]
50 53	623.7 1371.0 1994.7	50 53	592.9 1558.6 1951.5	50 53				1921.8	1805.3	2005.9	1951.5	—	—	[illegible].7	2221.5
21 28 37 38 49 57	266.3 13.5 5.0 11.3 484.1 2005.9 2792.7	21 28 37 38 49 57	178.9 11.3 5.0 6.3 272.3 1951.5 2425.9	21 28 37 38 49 57	43.9 15.1 12.6 17.9 0 [illegible]	[illegible] [illegible] [illegible] 26.8 13.6 [illegible]	6 11 13 44 [illegible]	2338.5	2206.2	[illegible]	2586.2	—	—	[illegible]362.5	4301.0
10 41	41.0 20.0 61.0	10 41	28.6 20.0 48.6	10 41	[illegible] 561.8 1134.7	[illegible] 357.7 1316.0	[illegible] 4	1261.5	1243.3	1371.0	1359.6	—	—	512.9	774.4

Figure DA-V-B-2 ALTERNATIVE III FLOW SUM

REFERENCE NUMBER	RURAL CONTRIBUTION 1990		RURAL FLOW DECREASE 1990 TO 2020 MGD	NAVAGATIONAL AND/OR RECREATIONAL TRANSFERS (1990 ONLY)		TRANSFER FLOW SOURCE (1990)		FLOW UPSTREAM FROM LAST REFERENCE NUMBER								
								1 9 9 0				2 0 2 0				
1	SUMMER MGD 2	WINTER MGD 3	4	SUMMER MGD 5	WINTER MGD 6	PLANT NUMBER 7	PLANT FLOW 8	SUMMER MGD 9	REFERENCE NUMBER 10	WINTER MGD 11	REFERENCE NUMBER 12	SUMMER MGD 13	REFERENCE NUMBER 14	WINTER MGD 15	REFERENCE NUMBER 16	1990 MGD 17
1	89.3*	0	0	35.6	35.6	9	54.3	—	—	—	—	—	—	—	—	-
2	85.5	0	30.1	—	—	—	—	124.9 17.3 8.4 150.6	1 33 34	35.6 8.7 5.0 49.3	1 33 34	124.9 17.3 8.4 150.6	1 33 34	35.6 8.7 5.0 49.3	1 33 34	-
3	0	0	0	5.7	5.7	10	61.7	—	—	—	—	—	—	—	—	—
4	2.1	0	2.1	3.6	3.6	10	61.7	—	—	—	—	—	—	—	—	
5	55.7	0	24.5	—	—	—	—	236.1 4.4 8.0 5.7 5.7 259.9	2 35 36 3 4	49.3 3.0 4.8 5.7 3.6 66.4	2 35 36 3 4	[illegible] 4.4 8.0 5.7 3.6 264.7	2 35 36 3 4	86.3 3.0 4.8 5.7 3.6 103.4	2 35 36 3 4	0 43.[illegible] 49.[illegible]
6	4.4	0	4.4	3.4	3.4	10	61.7	—	—	—	—	—	—	—	—	
7	4.8	0	1.2	5.0	5.0	9	54.3	—	—	—	—	—	—	—	—	-
8	4.8	0	1.2	11.8	11.8	29	31.4	—	—	—	—	—	—	—	—	—
9	8.6	0	3.4	11.8	11.8	29	31.4	—	—	—	—			—	—	-
10	0	0	0	100***	100***	DESPLAINES RIVER TRANSFER NO 1		9.8 16.6 20.4 46.8	7 8 9	5.0 11.8 11.8 28.6	7 8 9	8.6 15.4 17.0 41.0	7 8 9	5.0 11.8 11.8 28.6	7 8 9	—
11	2.0	0	2.0	10.4	10.4	2	48.6	—	—	—	—	—	—	—	—	—
12	25.9	0	6.5	—	—	—	—	12.4	11	10.4	11	10.4	11	10.4	11	24.[illegible] 6.[illegible] 30.[illegible]
13	0	0	0	6.3	6.3	33	32.6	—	—	—	—	—	)	—	—	—
14	0	0	0	6.3	6.3	2	48.6	—	—	—	—	—	—	—	—	-
15	2.9	0	1.7	20.1	20.1	33	32.6	6.3	14	6.3	14	6.3	14	6.3	14	—
16	4.0	0	4.0	—	—	—	—	29.3	15	26.4	15	27.6	15	26.4	15	9.3
17	0	0	0	7.7	7.7	2	48.6	—	—	—	—	—	—	—	—	—
18	22.0	0	12.9	—	—	—	—	7.7	17	7.7	17	7.7	17	7.7	17	—
19	24.2	0	13.3	34.5	34.5	41	51.2	29.7	18	7.7	18	16.8	18	7.7	18	32.7
20	0	0	0	7.4	7.4	41	51.2	—	—	—	—	—	—	—	—	—
21	85.7	0	18.9	-25.0	-25.0	DU PAGE TRANSFER NO.1		42.6 121.1 7.4 171.1	16 19 20	35.7 74.9 7.4 118.0	16 19 20	68.8 137.5 7.4 213.7	16 19 20	67.6 117.5 7.4 192.5	16 19 20	—

V-B-2 ALTERNATIVE III FLOW SUMMARY

SHEET / OF

AM FROM LAST REFERENCE NUMBER					RESIDUAL PLANT			ACCUMULATED FLOW IN STREAMS				MAXIMUM ALLOWABLE FLOW @ 18fps	MINIMUM FLOW	2020 WET FLOW INCREMENT	2020 ACUM WET FLOW (MAX FLOW)
0	2 0 2 0				INJECTIONS			1 9 9 0		2 0 2 0					
REFERENCE NUMBER 12	SUMMER MGD 13	REFERENCE NUMBER 14	WINTER MGD 15	REFERENCE NUMBER 16	1990 MGD 17	2020 MGD 18	PLANT NUMBER 19	SUMMER MGD 20	WINTER MGD 21	SUMMER MGD 22	WINTER MGD 23	24	25	26	27
—	—	—	—	—	—	—	—	124.3	35.6	124.3	35.6	[illegible]	[illegible]	—	
1 33 34	124.3 17.3 8.4 150.6	1 33 34	35.6 8.7 5.0 49.3	1 33 34	—	37.0	4	236.1	49.3	243.0	86.3	[illegible]	[illegible]	[illegible]	333.6
—	—	—	—	—	—	—	—	5.7	5.7	5.7	5.7	[illegible]	2.0	—	—
—	—	—	—	—	—	—	—	5.7	3.6	3.6	3.6	[illegible]	2.0	—	—
2 35 36 3 4	243.0 4.4 8.0 5.7 3.6 264.7	2 35 36 3 4	86.3 3.0 4.8 5.7 3.6 103.4	2 35 36 3 4	0 43.0 43.0	17.7 67.1 84.8	29 10	364.6	115.4	350.7	188.2	[illegible]	20.0	90.6	457.7
—	—	—	—	—	—	—	—	7.8	3.4	3.4	3.4	23.0	2.0	—	—
—	—	—	—	—	—	—	—	8.8	5.0	8.6	5.0	15.0	3.0	—	—
—	—	—	—	—	—	—	—	16.6	11.8	15.4	11.8	23.0	2.0	—	—
—			—	—			—	20.4	11.8	17.0	11.8	23.0	2.0	—	—
7 8 9	8.6 15.4 17.0 41.0	7 8 9	5.0 11.8 11.8 28.6	7 8 9	—	—	—	46.8	28.6	41.0	28.6	210.0	3.0	** 100.0	141.0
—	—	—	—	—	—	—	—	10.4	10.4	10.4	10.4	[illegible]	2.0	—	—
11	10.4	11	10.4	11	24.2 6.2 30.4	28.8 20.5 49.3	2 33	68.7	40.8	79.1	59.7	223.0	12.0	140.7	219.8
—	—	—	—	—	—	—	—	6.3	6.3	6.3	6.3	42.0	2.0	—	—
—	—		—	—	—	—		6.3	6.3	6.3	6.3	[illegible]	3.0	—	—
14	6.3	14	6.3	14	—		—	29.3	26.4	27.6	26.4	64.0	7.0	—	—
15	27.6	15	26.4	15	9.3	41.2	41.0	42.6	35.7	68.8	67.6	165.0	[illegible]	81.6	150.4
—	—	—	—	—	—	—	—	7.7	7.7	7.7	7.7	[illegible]	3.0	—	—
17	7.7	17	7.7	17	—	—	—	29.7	7.7	16.8	7.7	[illegible]	7.0	—	—
18	16.8	18	7.7	18	32.7	75.3	39	121.1	74.9	137.5	117.5	[illegible]	[illegible]	63.4	[illegible]
—	—	—	—	—	—	—	—	7.4	7.4	7.4	7.4	[illegible]	4.0	—	—
16 19 20	68.8 137.5 7.4 213.7	16 19 20	67.6 117.5 7.4 192.5	16 19 20	—	—	—	231.8 25.0 256.8	93.0 25.0 118.0	255.5 25.0 280.5	167.5 25.0 192.5	410.0	22.0	45.0	[illegible]

Figure DA-V-B-2 ALTERNATIVE III FLOW SUMMARY

REFERENCE NUMBER	RURAL CONTRIBUTION 1990		RURAL FLOW DECREASE 1990 TO 2020 MGD	NAVAGATIONAL AND/OR RECREATIONAL TRANSFERS (1990 ONLY)		TRANSFER FLOW SOURCE (1990)		FLOW UPSTREAM FROM LAST REFERENCE NUMBER								RESIDUAL F[...]	
								1990				2020				INJECTIO[...]	
	SUMMER MGD	WINTER MGD		SUMMER MGD	WINTER MGD	PLANT NUMBER	PLANT FLOW	SUMMER MGD	REFERENCE NUMBER	WINTER MGD	REFERENCE NUMBER	SUMMER MGD	REFERENCE NUMBER	WINTER MGD	REFERENCE NUMBER	1990 MGD	2020 MGD
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
22	3.6	0	0	5.1	5.1	14	51.1	—	—	—	—		—	—	—	—	—
23	1.4	0	1.4	6.0	6.0	14	51.1	—	—	—	—	—	—	—	—		—
24	15.6	0	13.4	—	—	—	—	7.4	40	6.0	40	6.[illegible]	40	6.0	40	3.3	[illegible]
25	11.1	0	10.9	13.1	13.1	14	51.1	—	—	—	—	—	—	—	—	—	—
26	0	0	0	9.0	9.0	CAL + SAG CHANNEL		—	—	—	—	—	—	—	—	—	—
27	3.5	0	3.5	4.1	4.1	CAL + SAG CHANNEL		—	—	—	—	—	—	—	—	—	—
28	13.8	0	5.6	11.3	11.3	14	51.1	—	—	—	—	—	—	—	—	—	—
29	11.5	0	0	10.5	10.5	8	119.3	—	—	—	—	—	—	—	—	—	—
30	39.9	0	3.2	18.0	18.0	8	119.3	—	—	—	—	—	—	—	—	—	—
31	2.2	0	0	5.1	5.1	16	50.4	—	—	—	—	—	—	—	—		
32	55.8	0	7.0	40.0	40.0	8	119.3	8.7 20.0 28.7	22 47a	5.1 20.0 25.1	22 47a	8.7 20.0 28.7	22 47a	5.1 20.0 25.1	22 47a	—	—
33	8.6*	0	0	8.7	8.7	9	54.3	—	—	—	—	—	—	—	—	—	—
34	3.4	0	0	5.0	5.0	9	54.3	—	—	—	—	—	—	—	—	—	—
35	1.4	0	0	3.0	3.0	29	31.4	—	—	—	—	—	—	—	—	—	—
36	3.2	0	0	4.8	4.8	29	31.4	—	—	—	—	—	—	—	—	—	—
37	0	0	0	5.0	5.0	CAL + SAG TRANSFER		—	—	—	—	—	—	—	—	—	—
38	5.0	0	0	6.3	6.3	14	51.1	—	—	—	—	—	—	—	—	—	—
39	0	0	0	5.0	5.0	LAKE MICHIGAN		—	—	—	—	—	—	—	—	—	—
40	1.4	0	1.4	6.0	6.0	14	51.1	—	—	—	—	—	—	—	—	—	—
41	0	0	0	20.0	20.0	3	352.9	—	—	—	—	—	—	—	—	—	—
42	0	0	0	75.0	75.0	7	376.5	—	—	—	—	—	—	—	—	—	—
43	55.4	0	6.4	—	—	—	—	—	—	—	—	—	—	—	—	10.1	17.8
44	0	0	0	10.0	10.0	15	241.2	—	—	—	—	—	—	—	—	—	—
45	0	0	0	35.0	35.0	NORTH BRANCH		—	—	—	—	—	—	—	—	—	—

B-2 ALTERNATIVE III FLOW SUMMARY

FROM LAST REFERENCE NUMBER					RESIDUAL PLANT INJECTIONS			ACCUMULATED FLOW IN STREAMS				MAXIMUM ALLOWABLE FLOW @ 1.8fps	MINIMUM FLOW	2020 WET FLOW INCREMENT	2020 ACUM WET FLOW (MAX FLOW)
	2020							1990		2020					
REFERENCE NUMBER 12	SUMMER MGD 13	REFERENCE NUMBER 14	WINTER MGD 15	REFERENCE NUMBER 16	1990 MGD 17	2020 MGD 18	PLANT NUMBER 19	SUMMER MGD 20	WINTER MGD 21	SUMMER MGD 22	WINTER MGD 23	24	25	26	27
—		—	—	—	—	—	—	8.7	5.1	8.7	5.1	[illegible]	2.0	[illegible]	25.2
—	—	—	—	—		—	—	7.4	6.0	6.0	6.0	[illegible]	2.0	—	—
40	6.0	40	6.0	40	3.3	[illegible]	14	[illegible]	9.3	31.6	23.4	[illegible]	[illegible]	—	—
—			—	—	—		—	[illegible]	13.1	13.3	13.1	57.0	2.0	—	—
—	—	—	—	—	—	—	—	9.0	9.0	9.0	9.0	[illegible]	2.0	—	—
—		—	—	—	—	—		7.6	4.1	4.1	4.1	27.0	2.0	—	—
—	—	—	—	—	—	—	—	25.1	11.3	19.5	11.3	75.0	3.0	—	—
—	—	—	—	—	—			22.0	10.5	22.0	10.5	[illegible]	2.0	—	—
—	—	—	—	—	—		—	57.9	18.0	54.7	18.0	[illegible]	3.0	—	—
—	—	—	—	—			—	7.3	5.1	7.3	5.1	34.0	2.0	—	—
22 47a	8.7 20.0 28.7	22 47a	5.1 20.0 25.1	22 47a	—	—	—	124.5	65.1	117.5	65.1	[illegible]	34.0	—	—
—	—	—				—	—	17.3	8.7	17.3	8.7	58.0	2.0	—	—
—	—	—	—	—	—	—	—	8.4	5.0	8.4	5.0	33.0	2.0	—	—
—	—	—	—	—	—	—	—	4.4	3.0	4.4	3.0	26.0	2.0	—	—
—	—	—	—	—	—	—		8.0	4.9	[illegible]	4.8	[illegible]	2.0	—	—
—	—	—	—	—	—	—	—	5.0	5.0	5.0	5.0	17.0	4.0	—	—
—	—	—	—	—	—	—	—	11.3	6.3	11.3	6.3	42.0	3.0	—	—
—	—	—	—			—	—	5.0	5.0	5.0	5.0	20.0	4.0	—	—
—	—	—	—	—	—	—	—	7.4	6.0	6.0	6.0	[illegible]	2.0	—	—
—	—	—	—	—	—	—	—	20.0	20.0	20.0	20.0	—	—	—	—
—	—	—	—	—	—	—	—	75.0	75.0	75.0	75.0	—	—	—	—
—	—	—	—	—	10.1	17.8	17	65.5	10.1	66.8	17.8	[illegible]	—	[illegible]	900
—	—	—	—	—	—	—	—	10.0	10.0	10.0	10.0	—	—	—	—
—	—	—	—	—	—	—	—	35.0	35.0	35.0	35.0	—	—	[illegible]	[illegible]

Figure DA-V-B-2 ALTERNATIVE III FLOW SUMMA

REFERENCE NUMBER	RURAL CONTRIBUTION 1990		RURAL FLOW DECREASE 1990 TO 2020 MGD	NAVAGATIONAL AND/OR RECREATIONAL TRANSFERS (1990 ONLY)		TRANSFER FLOW SOURCE (1990)		FLOW UPSTREAM FROM LAST REFERENCE NUMBER								RES
								1 9 9 0				2 0 2 0				II
1	SUMMER MGD 2	WINTER MGD 3	4	SUMMER MGD 5	WINTER MGD 6	PLANT NUMBER 7	PLANT FLOW 8	SUMMER MGD 9	REFERENCE NUMBER 10	WINTER MGD 11	REFERENCE NUMBER 12	SUMMER MGD 13	REFERENCE NUMBER 14	WINTER MGD 15	REFERENCE NUMBER 16	1990 MGD 17
46	159.0	0	38.8	—		—	—	22.0 57.9 7.3 124.5 211.7	29 30 31 32	10.5 18.0 5.1 65.1 98.7	29 30 31 32	22.0 54.7 7.3 117.5 201.5	29 30 31 32	10.5 18.0 5.1 65.1 98.7	29 30 31 32	[illegible]
47A	0	0	0	20.0	20.0	15	241.2	—	—	—	—	—	—	—	—	—
47B	0	0	0	20.0	20.0	15	241.2	—	—	—	—	—	—	—	—	—
48	14.5	0	3.0	—	—	—	—	5.0 10.0 15.0	39 44	5.0 10.0 15.0	39 44	5.0 10.0 15.0	39 44	5.0 10.0 15.0	39 44	50.8
49	0	0	0	—	—	—	—	364.6 7.8 68.7 6.3 447.4	5 6 12 13	115.4 3.4 40.8 6.3 165.9	5 6 12 13	380.7 3.4 79.1 6.3 469.5	5 6 12 13	188.2 3.4 59.7 6.3 257.6	5 6 12 13	—
50	46.7	0	18.3	—	—	—	—	7.4 26.3 24.2 — 3.5 75.0 20.0 156.4	23 24 25 26 27 42 476	6.0 9.3 13.1 — — 75.0 20.0 123.4	23 24 25 26 27 42 476	6.0 31.6 13.3 — — 75.0 20.0 145.9	23 24 25 26 27 42 476	6.0 29.4 13.1 — — 75.0 20.0 143.5	23 24 25 26 27 42 476	301.5 191.2 [illegible]
51	18.1	0	6.9	25.0*	25.0*	DU PAGE TRANSFER NO.1		695.8 1261.5	50 53	616.1 1243.3	50 53	657.6 1371.0	50 53	626.8 1358.6	50 53	—
52	0	0	0	100***	100***	DES PLAINES NO.2		46.8 20.0 66.8	10 41	28.6 20.0 48.6	10 41	41.0 20.0 61.0	10 41	28.6 20.0 48.6	10 41	332.9 861.8 1194.7
53	177.2	0	44.5	—	—	—	—	231.8 25.1 5.0 11.3 447.4 1975.4 2696.0	21 28 37 38 49 51	93.0 11.3 5.0 6.3 165.9 1859.4 2140.9	21 28 37 38 49 51	255.5 19.5 5.0 11.3 469.5 2039.8 2800.6	21 28 37 38 49 51	167.5 11.3 5.0 6.3 257.6 1985.4 2433.7	21 28 37 38 49 51	84.0 15.1 99.1

-V-B-2 ALTERNATIVE III FLOW SUMMARY

SHEET 3 OF 3

UPSTREAM FROM LAST REFERENCE NUMBER						RESIDUAL PLANT			ACCUMULATED FLOW IN STREAMS				MAXIMUM ALLOWABLE FLOW	MINIMUM FLOW	2020 WET FLOW INCREMENT	2020 ACUM WET FLOW (MAX FLOW)
9 0		2 0 2 0				INJECTIONS			1 9 9 0		2 0 2 0					
WINTER MGD 11	REFERENCE NUMBER 12	SUMMER MGD 13	REFERENCE NUMBER 14	WINTER MGD 15	REFERENCE NUMBER 16	1990 MGD 17	2020 MGD 18	PLANT NUMBER 19	SUMMER MGD 20	WINTER MGD 21	SUMMER MGD 22	WINTER MGD 23	@ 1.8fps 24	25	26	27
10.5 18.0 5.1 65.1 98.7	29 30 31 32	22.0 54.7 7.3 117.5 201.5	29 30 31 32	10.5 18.0 5.1 65.1 98.7	29 30 31 32	[illegible]	[illegible]	12	416.0	144.0	430.0	207.0	—	—	49.4	475.4
—	—	—	—	—	—	—	—	—	20.0	20.0	20.0	20.0	—	8.0	—	
—	—	—	—	—	—	—	—	—	20.0	20.0	20.0	20.0	—	8.0	—	—
5.0 10.0 15.0	39 44	5.0 10.0 15.0	39 44	5.0 10.0 15.0	39 44	50.8	72.6	8	75.3	60.8	34.1	82.6	—	—	63.5	142.6
115.4 3.4 40.8 6.3 165.9	5 6 12 13	380.7 3.4 79.1 6.3 469.5	5 6 12 13	188.2 3.4 59.7 6.3 257.6	5 6 12 13	—	—	—	447.4	165.9	469.5	257.6	—	—	157.7	622.2
6.0 9.3 13.1 — — 75.0 20.0 23.4	23 24 25 26 27 42 476	6.0 31.6 13.3 — — 75.0 20.0 145.9	23 24 25 26 27 42 476	6.0 29.4 13.1 — — 75.0 20.0 143.5	23 24 25 26 27 42 476	301.5 191.2 492.7	367.0 116.3 483.3	7 15	695.8 -5.0 694.8	616.1 -5.0 611.1	657.6 -5.0 652.6	626.8 -5.0 621.8	—	—	356.0	997.6
16.1 43.3	50 53	657.6 1371.0	50 53	626.8 1358.6	50 53	—	—	—	1970.4	1854.4	2034.8	1980.4	—	—	1068.9	317.5
28.6 20.0 48.6	10 41	41.0 20.0 61.0	10 41	28.6 20.0 48.6	10 41	332.9 861.8 1194.7	372.3 937.7 1310.0	3 4	1261.5	1243.3	1371.0	1358.6	—	—	2430.2	4674.5
93.0 11.3 5.0 6.3 65.9 59.4 40.9	21 28 37 38 49 51	255.5 19.5 5.0 11.3 469.5 2039.8 2800.6	21 28 37 38 49 51	167.5 11.3 5.0 6.3 257.6 1985.4 2433.7	21 28 37 38 49 51	84.0 15.1 99.1	147.9 19.3 167.2	6 11	2967.3 25.0 2992.3	2235.0 25.0 2260.0	3095.5 25.0 3120.5	2595.3 25.0 2620.3	—	—	—	—

2

Figure DA-V-B-3 ALTERNATIVE IV FLOW SUMMA

REFERENCE NUMBER	RURAL CONTRIBUTION 1990		RURAL FLOW DECREASE 1990 TO 2020 MGD	NAVAGATIONAL AND/OR RECREATIONAL TRANSFERS (1990 ONLY)		TRANSFER FLOW SOURCE (1990)		FLOW UPSTREAM FROM LAST REFERENCE NUMBER								RESIDUAL	
								1990				2020				INJECTI	
	SUMMER MGD	WINTER MGD		SUMMER MGD	WINTER MGD	PLANT NUMBER	PLANT FLOW	SUMMER MGD	REFERENCE NUMBER	WINTER MGD	REFERENCE NUMBER	SUMMER MGD	REFERENCE NUMBER	WINTER MGD	REFERENCE NUMBER	1990 MGD	2020 MGD
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	89.3	0		35.6	35.6	1	—	—	—	—	—	—	—	—	—	[illegible]	[illegible]
2	85.5	[illegible]	[illegible]	—	—	—	—	[illegible] [illegible] 5.4 [illegible]	[illegible]	35.6 5.7 5.0 41.3	1 33 34	124.3 17.3 5.4 50.6	1 33 34	[illegible] 5.7 5.0 41.3	[illegible] 34	[illegible]	[illegible]
3	0	0	0	5.7	5.7	4	5.7	—	—	—	—	—	—	—			
4	2.1	0	2.1	3.6	3.6	4	3.6	—	—	—	—	—	—	—	—		
5	55.7	0	24.5	—	—	—	—	281.5 4.4 5.0 5.7 5.7 286.3	2 35 36 3 4	[illegible]	2 35 36 3 4	[illegible] 4.4 [illegible] 5.7 5.7 357.4	2 35 36 3 4	[illegible]	[illegible]	[illegible]	[illegible]
6	4.4	0	4.4	3.4	3.4	—	—	—	—	—	—	—			—		
7	4.8	0	1.2	5.0	5.0	1	5.0	—	—	—	—	—		—	—		
8	4.8	0	1.2	11.8	11.8	2	11.8	—	—	—	—	—	—	—	—		
9	8.6	0	3.4	11.8	11.8	2	11.8	—	—	—	—	—	—	—	—		
10	0	0	0	100.0 (SUMMER ONLY)	—	DESPLAINES RIVER TRANSFER NO. 6		[illegible] 16.6 20.4 46.8	7 8 9	5.0 11.8 11.8 28.6	7 8 9	8.6 15.4 17.0 41.0	[illegible]	[illegible] 11.8 11.8 [illegible]	[illegible]		
11	2.0	0	2.0	10.4	10.4	3	0.4	—	—	—	—	—		—	—		
12	25.9	0	6.5	—	—	—	—	12.4	11	10.4	11	10.4	11	10.4	11	[illegible]	[illegible]
13	0	0	0	6.3	6.3	5	6.3	—	—	—	—	—					
14	0	0	0	6.3	6.3	3	6.3	—	—	—	—	—	—	—	—		
15	2.9	0	1.7	20.1	20.1	5	20.1	6.3	14	6.3	14	6.3	14	6.3	14	—	—
16	4.0	0	4.0	—	—	—	—	29.3	15	26.4	15	27.6	15	26.4	15	178.9 9.3	157.3 41.
17	0	0	0	7.7	7.7	3	7.7	—	—	—	—	—	—	—	—	—	—
18	22.0	0	12.9	—	—	—	—	7.7	17	7.7	17	7.7	17	7.7	17	—	—
19	24.2	0	13.3	34.5	34.5	KENDALL COUNTY		29.7	18	7.7	18	16.8	18	7.7	18	77.7 32.7	139.7 75.
20	0	0	0	7.4	7.4	7	7.4	—	—	—	—	—	—	—	—	—	—
21	85.9	0	18.9	25.0	0	TRANSFER TO DES PLAINES		142.2 166.1 7.4 315.7	16 19 20	35.7 74.9 7.4 118.0	16 19 20	184.9 200.9 7.4 383.2	16 19 20	67.6 117.5 7.4 192.5	16 19 20	—	—

-V-B-3 ALTERNATIVE IV FLOW SUMMARY

SHEET / OF

M FROM LAST REFERENCE NUMBER					RESIDUAL PLANT					ACCUMULATED FLOW IN STREAMS				MAXIMUM ALLOWABLE FLOW @ 1.8fps	MINIMUM FLOW	2020 WET FLOW INCREMENT	2020 ACUM WET FLOW (MAX FLOW)
)	2 0 2 0				INJECTIONS					1 9 9 0		2 0 2 0					
EFERENCE NUMBER 12	SUMMER MGD 13	REFERENCE NUMBER 14	WINTER MGD 15	REFERENCE NUMBER 16	1990 MGD 17		2020 MGD 18		PLANT NUMBER 19	SUMMER MGD 20	WINTER MGD 21	SUMMER MGD 22	WINTER MGD 23	24	25	26	27
—	—	—		—	[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.0		
2 33 34	124.3 17.3 8.4 50.6	2 33 34	[illegible] 8.7 [illegible] [illegible]	[illegible] [illegible] 34	[illegible]	[illegible]	[illegible]	[illegible]	2	[illegible]	[illegible]	[illegible]	72.3	340.0	6.0		
—	—	—	—							5.7	5.7	[illegible]	[illegible]	38.0	2.0	—	—
—	—	—	—	—					—	5.7	[illegible]	[illegible]	[illegible]	14.0	2.0	—	
2 35 36 3 4	[illegible] 4.4 8 [illegible] [illegible] 357.4	2 35 36 3 4	[illegible] [illegible] [illegible] [illegible] [illegible] [illegible]	[illegible] [illegible] [illegible] [illegible]	4 [illegible] [illegible]	[illegible]	[illegible]	[illegible]	2 4	487.5 -100.0 387.5	115.4	[illegible] -100.0 300.0	178.2	500.0	20.0	—	
—	—		—	—					—	7.8	3.4	7.8	3.4	23.0	2.0	—	—
—	—		—	—						[illegible]	[illegible]	8.6	[illegible]	15.0	3.0	—	
—	—	—	—	—					—	[illegible]	[illegible]	5.4	11.8	23.0	2.0	—	—
—	—	—	—	—					—	20.4	[illegible]	7.0	11.8	23.0	2.0	—	—
7 8 9	8.6 15.4 17.0 41.0	[illegible]	[illegible] [illegible] 11.8 [illegible]	[illegible]					—	46.8	[illegible]	141.0	28.6	210.0	3.0	—	—
—	—	—	—	—						[illegible]	[illegible]	[illegible]	[illegible]	69.0	2.0	—	—
11	10.4	11	10.4	11	[illegible]	24.2	[illegible]	[illegible]	8	[illegible]	[illegible]	[illegible]	25.7	223.0	12.0	—	—
—	—		—	—	—	—			—	[illegible]	6.3	6.3	[illegible]	42.0	2.0	—	—
—	—	—	—	—		—	—	—	—	[illegible]	[illegible]	[illegible]	[illegible]	25.0	3.0	—	—
14	6.3	14	6.3	14	—	—	—	—	—	29.3	26.4	27.6	26.4	84.0	7.0	—	—
15	27.6	15	26.4	15	158.9	9.3	157.3	41.2	7	142.2	35.7	184.9	67.6	165.0	9.0	—	—
—	—	—	—	—	—	—	—	—	—	7.7	7.7	7.7	7.7	51.0	3.0	—	—
17	7.7	17	7.7	17	—	—	—	—	—	29.7	7.7	16.8	7.7	109.0	7.0	—	—
18	16.8	18	7.7	18	77.7	32.7	139.7	75.3	6	166.1	74.9	200.9	117.5	230.0	9.0	—	—
—	—	—	—	—	—	—	—	—	—	7.4	7.4	7.4	7.4	49.0	4.0	—	—
16 19 20	184.9 200.9 7.4 383.2	16 19 20	67.6 117.5 7.4 192.5	16 19 20	—	—	—	—	—	376.6	118.0	425.2	192.5	410.0	22.0	—	—

Figure DA-V-B-3 ALTERNATIVE IV FLOW SUM

REFERENCE NUMBER	RURAL CONTRIBUTION 1990		RURAL FLOW DECREASE 1990 TO 2020 MGD	NAVAGATIONAL AND/OR RECREATIONAL TRANSFERS (1990 ONLY)		TRANSFER FLOW SOURCE (1990)		FLOW UPSTREAM FROM LAST REFERENCE NUMBER								RE
								1 9 9 0				2 0 2 0				
	SUMMER MGD	WINTER MGD		SUMMER MGD	WINTER MGD	PLANT NUMBER	PLANT FLOW	SUMMER MGD	REFERENCE NUMBER	WINTER MGD	REFERENCE NUMBER	SUMMER MGD	REFERENCE NUMBER	WINTER MGD	REFERENCE NUMBER	1990 MGD
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
22	3.6	0	0	5.1	5.1	2	5.1		—		—					—
23	1.4	0	1.4	6.0	6.0	12	6.0	—	—	—	—	—	—	—	—	—
24	15.6	0	13.4	—	—	—	—	7.4	40	6.0	40	6.0	40	6.0	40	6.05
25	11.1	0	10.9	13.1	13.1	12	13.1	—	—	—	—	—	—	—	—	
26	0	0	0	9.0	9.0	CAL-SAG TRANSFER		—	—	—	—	—	—	—	—	—
27	3.5	0	3.5	4.1	4.1	CAL-SAG TRANSFER		—	—	—	—	—	—	—	—	—
28	13.8	0	5.6	11.3	11.3	12	11.3	—	—	—	—	—	—	—	—	—
29	11.5	0	0	10.5	10.5	14	10.5	—	—	—	—	—	—	—	—	—
30	39.9	0	3.2	18.0	18.0	14	18.0	—	—	—	—	—	—	—	—	—
31	2.2	0	0	5.1	5.1	15	5.1	—	—	—	—	—	—	—	—	—
32	55.8	0	7.0	40.0	40.0	14	40.0	8.7 20.0	22 47a	5.1 20.0	22 47a	8.7 20.0	22 47a	5.1 20.0	22 47a	—
33	8.6*	0	0	8.7	8.7	1	8.7	—	—	—	—	—		—	—	—
34	3.4	0	0	5.0	5.0	1	5.0	—	—	—	—	—	—	—	—	—
35	1.4	0	0	3.0	3.0	2	3.0	—	—	—	—	—	—	—	—	—
36	3.2	0	0	4.8	4.8	2	4.8	—	—	—	—			—	—	—
37	0	0	0	5.0	5.0	CAL-SAG TRANSFER		—	—	—	—	—	—	—	—	—
38	5.0	0	0	6.3	6.3	12	6.3	—	—	—	—	—	—	—	—	—
39	0	0	0	5.0	5.0	LAKE MICHIGAN TRANSFER		—	—	—	—	—	—	—	—	—
40	1.4	0	1.4	6.0	6.0	12	6.0	—	—	—	—	—	—	—	—	—
41	0	0	0	20.0	20.0	DES PLAINES DIST TUNNEL	—	—	—	—	—	—	—	—	—	—
42	0	0	0	75.0	75.0	11	75.0	—	—	—	—	—	—	—	—	—

ARY

DA-V-B-3 ALTERNATIVE IV FLOW SUMMARY

SHEET 2 OF

(ECTIONS) 2020 MGD 18	UPSTREAM FROM LAST REFERENCE NUMBER — 1990 — WINTER MGD 11	REFERENCE NUMBER 12	2020 — SUMMER MGD 13	REFERENCE NUMBER 14	WINTER MGD 15	REFERENCE NUMBER 16	RESIDUAL PLANT INJECTIONS — 1990 MGD 17	2020 MGD 18	PLANT NUMBER 19	ACCUMULATED FLOW IN STREAMS — 1990 — SUMMER MGD 20	WINTER MGD 21	2020 — SUMMER MGD 22	WINTER MGD 23	MAXIMUM ALLOWABLE FLOW @ 1.8 fps 24	MINIMUM FLOW 25	2020 WET FLOW INCREMENT 26	2020 ACUM WET FLOW (MAX FLOW) 27
—		—					— —	—	—	8.7	5.1	8.7	[illegible]	34.0	2.0	—	—
	—	—	—	—	—	—	— —			7.4	6.0	6.0	6.0	40.0	2.0	—	—
7 3.4	6.0	40	6.0	40	6.0	40	6.05 3.3	13.7 3.4	12	25.5	[illegible].3	121.9	25.4	90.0	14.0	—	—
—	—	—	—	—	—	—		— —	—	14.2	13.1	13.3	13.1	87.0	2.0	—	—
—	—	—	—	—	—	—	— —	— —	—	9.0	9.0	9.0	9.0	60.0	2.0	—	—
—	—	—	—	—	—	—	— —	— —	—	7.6	4.1	4.1	4.1	27.0	2.0	—	—
—	—	—	—	—	—	—	— —	— —	—	25.1	11.3	12.5	11.3	75.0	9.0	—	—
—	—	—	—	—	—	—	— —	— —	—	22.0	10.5	22.0	10.5	70.0	2.0	—	—
—	—	—	—	—	—	—	— —	— —	—	57.9	18.0	54.7	18.0	120.0	3.0	—	—
—	—	—	—	—	—	—	—	—		7.3	5.1	7.3	5.1	34.0	2.0	—	—
—	5.1 20.0	22 47a	8.7 20.0	22 47a	5.1 20.0	22 47a	— —	— —	—	124.5	25.1	17.5	25.1	400.0	34.0	—	—
—	—	—	—		—	—	— —	— —	—	17.3	8.7	17.3	8.7	58.0	2.0	—	—
—	—	—	—	—	—	—	— —	— —	—	8.4	5.0	8.4	5.0	33.0	2.0	—	—
—	—	—	—	—	—	—	— —	— —	—	4.4	3.0	4.4	3.0	20.0	2.0	—	—
—	—	—				—	— —	— —	—	8.0	4.8	8.0	4.8	32.0	2.0	—	—
—	—	—	—	—	—	—	— —	— —	—	5.0	5.0	5.0	5.0	17.0	4.0	—	—
—	—	—	—	—	—	—	— —	— —	—	11.3	6.3	11.3	6.3	42.0	3.0	—	—
—	—	—	—	—	—	—	— —	— —	—	5.0	5.0	5.0	5.0	20.0	4.0	—	—
—	—	—	—	—	—	—	— —	— —	—	7.4	6.0	6.0	6.0	40.0	2.0	—	—
—	—	—	—	—	—	—	— —	— —	—	20.0	20.0	20.0	20.0	—	—	—	—
—	—	—	—	—		—	— —	— —	—	75.0	75.0	75.0	75.0	—	—	—	—

2

Figure DA-V-B-3 ALTERNATIVE IV FLOW SUM

REFERENCE NUMBER	RURAL CONTRIBUTION 1990		RURAL FLOW DECREASE 1990 TO 2020 MGD	NAVAGATIONAL AND/OR RECREATIONAL TRANSFERS (1990 ONLY)		TRANSFER FLOW SOURCE (1990)		FLOW UPSTREAM FROM LAST REFERENCE NUMBER							
								1990				2020			
	SUMMER MGD	WINTER MGD		SUMMER MGD	WINTER MGD	PLANT NUMBER	PLANT FLOW	SUMMER MGD	REFERENCE NUMBER	WINTER MGD	REFERENCE NUMBER	SUMMER MGD	REFERENCE NUMBER	WINTER MGD	REFERENCE NUMBER
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
43	55.4	0	5.4	—	—	—	—	—	—	—	—	—	—	—	—
44	0	0	0	10.0	10.0	13	10.0	—	—	—	—	—	—	—	—
45	0	0	0	35.0	35.0	NORTH BRANCH TRANSFER		—	—	—	—	—	—	—	—
46	59.0	0	38.8	—	—	—	—	22.0 57.9 7.3 124.5 211.7	29 30 31 32	10.5 18.0 5.1 65.1 98.7	29 30 31 32	22.0 54.7 7.3 117.5 201.5	29 30 31 32	[illegible] [illegible] 5.1 65.1 98.7	29 30 31 32
47A	0	0	0	20.0	20.0	—	—	—	—	—	—	—	—	—	—
47B	0	0	0	20.0	20.0	—	—	—	—	—	—	—	—	—	—
48	14.5	0	3.0	—	—	—	—	10.0	39 44	10.0	39 44	10.0	39 44	10.0	39 44
49	0	0	0	—	—	—	—	387.5 7.8 184.6 6.3 586.2	5 6 12 13	115.4 5.4 40.8 6.3 167.9	5 6 12 13	500.0 7.8 219.8 6.3 733.9	5 6 12 13	178.2 5.4 59.7 6.3 249.6	5 6 12 13
50	46.7	0	18.3	—	—	—	—	7.4 83.5 24.2 75.0 20.0 210.1	23 24 25 26 27 42 47B	6.0 9.3 13.1 75.0 20.0 123.4	23 24 25 26 27 42 47B	6.0 121.9 13.3 75.0 20.0 236.2	23 24 25 26 27 42 47B	6.0 29.4 13.1 75.0 20.0 143.5	23 24 25 26 27 42 47B
51	18.1	0	6.9	125.0	—	DUPAGE TRANSFER		1776.1 266.8 2042.9	50 53	123.4 48.6 172.0	50 53	1984.2 261.0 2245.2	50 53	143.5 48.6 192.1	50 53
52	177.2	0	44.5	—	—	—	—	376.6 26.1 5.0 11.3 486.2 3363.3 4267.5	21 28 37 38 49 51	118.0 11.3 5.0 6.3 167.9 208.3 666.8	21 28 37 38 49 51	426.2 12.5 5.0 11.3 633.9 3749.1 4854.0	21 28 37 38 49 51	192.5 11.3 5.0 6.3 249.6 192.1 656.8	21 28 37 38 49 51
53	0	0	0	100.0	0	DES PLAINES TRANSFER		146.8 20.0 166.8	10 41	28.6 20.0 48.6	10 41	141.0 20.0 161.0	10 41	28.6 20.0 48.6	10 41

-V-B-3 ALTERNATIVE IV FLOW SUMMARY

SHEET 2 OF 3

						RESIDUAL PLANT INJECTIONS					ACCUMULATED FLOW IN STREAMS							
PSTREAM FROM LAST REFERENCE NUMBER											1990		2020		MAXIMUM ALLOWABLE FLOW @ 1.8fps	MINIMUM FLOW	2020 WET FLOW INCREMENT	2020 ACUM WET FLOW (MAX FLOW)
0		2020				1990 MGD 17		2020 MGD 18		PLANT NUMBER 19	SUMMER MGD 20	WINTER MGD 21	SUMMER MGD 22	WINTER MGD 23	24	25	26	27
(WI)NTER MGD 11	REFERENCE NUMBER 12	SUMMER MGD 13	REFERENCE NUMBER 14	WINTER MGD 15	REFERENCE NUMBER 16	SUM.	WIN.	SUM.	WIN.									
—	—	—	—	—	—	—	—	—	—	—	55.4	0	49.0	0	140.0	—	—	—
—	—	—	—	—	—	—	—	—	—	—	10.0	0.0	10.0	10.0	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	35.0	35.0	35.0	35.0	—	—	—	—
.5 .0 .1 .1 .7	29 30 31 32	22.0 54.7 7.3 117.5 201.5	29 30 31 32	10.5 18.0 5.1 65.1 98.7	29 30 31 32	58.5	20.0	57.7	20.0	15	429.2	118.7	479.4	118.7	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	20.0	20.0	20.0	20.0	—	8.0	—	—
—	—	—	—	—	—	—	—	—	—	—	20.0	20.0	20.0	20.0	—	8.0	—	—
.0	39 44	10.0	39 44	10.0	39 44	96.9	0	136.1	0	14	121.4	10.0	147.6	10.0	—	—	—	—
.4 .4 .8 .3 .9	5 6 12 13	500.0 7.8 219.8 6.3 733.9	5 6 12 13	178.2 5.4 59.7 6.3 249.6	5 6 12 13	—	—	—	—	—	586.2 -100.0 486.2	167.9	733.9 -100.0 633.9	249.6	—	—	—	—
.0 .3 .1 .0 .0 .4	23 24 25 26 27 42 47b	6.0 121.9 13.3 75.0 20.0 236.2	23 24 25 26 27 42 47b	6.0 29.4 13.1 75.0 20.0 143.5	23 24 25 26 27 42 47b	176.9 234.0 3070 519.3	0 0 0	582.1 449 370.6 1779.4	0 0 0	11 13 OVERFLOW	776.1	123.4	984.2	143.5	—	—	—	—
.4 .6 .0	50 53	1984.2 261.0 2245.2	50 53	143.5 48.6 192.1	50 53	[illegible] 275 2734	1863 0 1863	1050 432 1482	0 0 0	OVERFLOW	3363.3 +31.7	358.9 +13.4	3749.1 +31.7	192.1 +3.4	—	—	—	—
.0 .3 .0 .3 .9 .3 .8	21 28 37 38 49 51	426.2 15.5 5.0 11.3 633.9 3749.1 4854.0	21 28 37 38 49 51	192.5 11.3 5.0 6.3 249.6 192.1 656.8	21 28 37 38 49 51	151	0	153	0	10	4452.8	666.8	5006.0	656.8	—	—	—	—
.6 .0 .6	10 41	141.0 20.0 161.0	10 41	28.6 20.0 48.6	10 41	—	—	—	—	—	266.8 31.7	48.6 13.4	261.0 31.7	48.6 13.4	—	—	—	—

2

Figure DA-V-B-4 ALTERNATIVE V FLOW SUMMARY

REFERENCE NUMBER 1	RURAL CONTRIBUTION 1990 SUMMER MGD 2	RURAL CONTRIBUTION 1990 WINTER MGD 3	RURAL FLOW DECREASE 1990 TO 2020 MGD 4	NAVAGATIONAL AND/OR RECREATIONAL TRANSFERS (1990 ONLY) SUMMER MGD 5	NAVAGATIONAL AND/OR RECREATIONAL TRANSFERS (1990 ONLY) WINTER MGD 6	TRANSFER FLOW SOURCE (1990) PLANT NUMBER 7	TRANSFER FLOW SOURCE (1990) PLANT FLOW 8	FLOW UPSTREAM FROM LAST REFERENCE NUMBER 1990 SUMMER MGD 9	1990 REFERENCE NUMBER 10	1990 WINTER MGD 11	1990 REFERENCE NUMBER 12	2020 SUMMER MGD 13	2020 REFERENCE NUMBER 14	2020 WINTER MGD 15	2020 REFERENCE NUMBER 16	RESIDU[AL] INJE[CTION] 1990 MGD 17	20[20] M[GD] 1[8]
23	1.4	0	1.4	[illegible]	[illegible]	2	[illegible]	—	—			—	—		—	[illegible]	—
24	15.6	0	13.4	—	—		—	7.4	40	[illegible]	40	[illegible]	[illegible]	[illegible]	40	[illegible]	[illegible]
25	11.1	0	10.9	3.1	13.1	12	13.1	—	—	—	—	—	—	—	—	—	—
26	0	0	0	9.0	5.0	CAL SAG TRANSFER		—	—	—	—	—	—	—	—	—	—
27	3.5	0	3.5	4.1	4.1	CAL SAG TRANSFER		—	—	—	—	—	—	—	—	—	—
28	13.8	0	5.6	11.3	11.3	12	11.3	—	—	—	—	—	—	—	—	—	—
29	11.5	0	0	10.5	10.5	14	10.5	—	—	—	—	—	—	—	—	—	—
30	39.9	0	3.2	18.0	18.0	14	18.0	—	—	—	—	—	—	—	—	—	—
31	2.2	0	0	5.1	5.1	15	5.1	—	—	—	—	—	—	—	—	—	—
32	55.8	0	7.0	42.0	40.0	14	40.0	28.8	22,47a	25.1	—	28.7	—	25.1	—	—	—
33	8.6*	0	0	8.7	8.7	1	8.7	—	—	—	—	—	—	—	—	—	—
34	3.4	0	0	5.0	5.0	1	5.0	—	—	—	—	—	—	—	—	—	—
35	1.4	0	0	3.0	3.0	2	3.0	—	—	—	—	—	—	—	—	—	—
36	3.2	0	0	4.8	4.8	2	4.8	—	—	—	—	—	—	—	—	—	—
37	0	0	0	5.0	5.0	CAL SAG TRANSFER		—	—	—	—	—	—	—	—	—	—
38	5.0	0	0	6.3	6.3	12	6.3	—	—	—	—	—	—	—	—	—	—
39	0	0	0	5.0	5.0	LAKE MICHIGAN TRANSFER		—	—	—	—	—	—	—	—	—	—
40	1.4	0	1.4	6.0	6.0	12	6.0	—	—	—	—	—	—	—	—	—	—
41	0	0	0	20.0	20.0	3	20.0	—	—	—	—	—	—	—	—	—	—
42	0	0	0	75.0	75.0	11	75.0	—	—	—	—	—	—	—	—	—	—
43	55.4	0	6.4	—	—	—	—	—	—	—	—	—	—	—	—	—	—
44	0	0	0	10.0	10.0	3	10.0	—	—	—	—	—	—	—	—	—	—

-4 ALTERNATIVE V FLOW SUMMARY

SHEET 1 OF [illegible]

FROM LAST REFERENCE NUMBER					RESIDUAL PLANT					ACCUMULATED FLOW IN STREAMS							
	2 0 2 0				INJECTIONS					1 9 9 0		2 0 2 0		MAXIMUM ALLOWABLE FLOW @ 1.8fps	MINIMUM FLOW	2020 WET FLOW INCREMENT	2020 ACUM WET FLOW (MAX FLOW)
ERENCE MBER 12	SUMMER MGD 13	REFERENCE NUMBER 14	WINTER MGD 15	REFERENCE NUMBER 16	1990 MGD 17		2020 MGD 18		PLANT NUMBER 19	SUMMER MGD 20	WINTER MGD 21	SUMMER MGD 22	WINTER MGD 23	24	25	26	27
					S W	W N	S W	W N									
—	—	—		—	—		—	—		7.4	6.0	6.0	6.0	[illegible]	2.0	—	—
40	6.0	4	[illegible]	40	[illegible]	11.3	119.7	32.5	12	83.5	17.9	121.5	38.0	[illegible]	4.0	—	
—	—	—	—	—	—	—	—	—	—	24.2	13.1	13.3	3.1	57.0	2.0	—	—
—	—	—	—	—	—	—	—	—	—	[illegible]	[illegible]	[illegible]	5.0	30.0	2.0	—	—
—	—	—	—	—	—	—	—	—	—	7.6	4.1	4.1	4.1	27.0	2.0	—	—
—	—		—	—	—	—	—	—	—	25.1	11.3	[illegible]	11.3	75.0	3.0	—	—
—	—	—	—	—	—	—	—	—	—	22.0	10.5	22.0	10.5	70.0	2.0	—	
—	—	—	—	—	—	—		—	—	57.9	8.0	54.7	18.0	120.0	3.0	—	—
—	—	—	—	—	—	—	—	—	—	7.3	5.1	7.3	5.1	34.0	2.0	—	—
—	28.7	—	25.1	—	—	—	—	—	—	124.5	65.1	117.5	65.1	400.0	34.0	—	—
—	—	—	—	—	—	—	—	—	—	17.3	8.7	17.3	8.7	58.0	2.0	—	—
—	—	—	—	—	—	—	—	—	—	8.4	5.0	8.4	5.0	33.0	2.0	—	—
—	—	—	—	—	—	—	—	—	—	4.4	3.0	4.4	3.0	20.0	2.0	—	—
—	—	—	—	—	—	—	—	—	—	8.0	4.8	8.0	4.8	32.0	2.0	—	—
—	—	—	—	—	—	—	—	—	—	5.0	5.0	5.0	5.0	17.0	4.0	—	—
—	—	—	—	—	—	—	—	—	—	11.3	6.3	11.3	6.3	42.0	3.0	—	—
—	—	—	—	—	—	—	—	—	—	5.0	5.0	5.0	5.0	20.0	4.0	—	—
—	—	—	—	—	—	—	—	—	—	7.4	6.0	6.0	6.0	40.0	2.0	—	—
—	—	—	—	—	—	—	—	—	—	20.0	20.0	20.0	20.0	—	—	—	—
—	—	—	—	—	—	—	—	—	—	75.0	75.0	75.0	75.0	—	—	—	—
—	—	—	—	—	—	—	—	—	—	55.4	0	49.0	—	140.0	—	—	—
—	—	—	—	—	—	—	—	—	—	10.0	10.0	10.0	10.0	—	—	—	

2

Figure DA-V-B-4 ALTERNATIVE V FLOW SUMMARY

REFERENCE NUMBER	RURAL CONTRIBUTION 1990		RURAL FLOW DECREASE 1990 TO 2020 MGD	NAVIGATIONAL AND/OR RECREATIONAL TRANSFERS (1990 ONLY)		TRANSFER FLOW SOURCE (1990)		FLOW UPSTREAM FROM LAST REFERENCE NUMBER								RESIDUAL … INJECTION …	
								1990				2020					
	SUMMER MGD	WINTER MGD		SUMMER MGD	WINTER MGD	PLANT NUMBER	PLANT FLOW	SUMMER MGD	REFERENCE NUMBER	WINTER MGD	REFERENCE NUMBER	SUMMER MGD	REFERENCE NUMBER	WINTER MGD	REFERENCE NUMBER	1990 MGD	2020 MGD
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	85.3	—	0	35.6	35.6	1	—									S.M.	S.M.
2	85.5	0	30.1	—	—	—	—	50.6	1,33,34	[illegible]	33,34	[illegible]	33,34	45.3	33,34	[illegible]	[illegible]
3	0	0	0	5.7	5.7	4	5.7	—	—	—	—	—	—	—	—	—	—
4	2.1	0	2.1	3.6	3.6	4	3.6	—	—	—	—	—	—	—			
5	55.7	0	24.5	0	0	—	—	286.3	2,34,36,34	64.4	—	357.4	—	73.4	—	[illegible]	[illegible]
6	4.4	0	4.4	3.4	3.4	—	—	—	—	—	—	—	—	—	—	—	—
7	4.8	0	1.2	5.0	5.0	[illegible]	5.0	—	—	—	—	—	—	—	—	—	—
8	4.8	0	1.2	11.8	11.8	2	11.8	—	—	—	—	—	—	—	—	—	—
9	8.6	0	3.4	11.8	11.8	2	11.8	—	—	—	—	—	—	—	—	—	—
10	0	0	0	100.0	—	DES PLAINES TRANSFER 16.5		46.8	7,8,9	28.6	—	41.0	—	24.4	—	—	—
11	2.0	0	2.0	10.4	10.4	3	10.4	—	—	—	—	—	—	—	—	—	—
12	26.9	0	6.5	—	—	—	—	12.4	11	10.4	11	10.4	11	[illegible]	11	[illegible]	[illegible]
13	0	0	0	6.3	6.3	5	6.3	—	—	—	—	—	—	—	—	—	—
14	0	0	0	6.3	6.3	3	6.3	—	—	—	—	—	—	—	—	—	—
15	2.9	0	1.7	20.1	20.1	5	20.1	6.3	14	6.3	14	6.3	14	[illegible]	14	—	—
16	4.0	0	4.0	—	—	—	—	29.3	15	26.4	15	27.6	15	24.4	15	[illegible]	[illegible]
17	0	0	0	7.7	7.7	9	7.7	—	—	—	—	—	—	—	—	—	—
18	22.0	0	12.9	—	—	—	—	7.7	17	7.7	17	7.7	17	7.7	17	—	—
19	24.2	0	13.3	34.5	34.5	KENDALL WINTER		29.7	18	7.7	18	16.8	18	7.7	18	[illegible]	[illegible]
20	0	0	0	7.4	7.4	7	7.4	—	—	—	—	—	—	—	—	—	—
21	86.9	0	18.9	-25.0	0	DES PLAINES TRANSFER		315.7	16,19,20	118.0	—	383.2	—	92.5	—	—	—
22	3.6	0	0	5.1	5.1	12	5.1	—	—	—	—	—	—	—	—	—	—

A-V-B-4 ALTERNATIVE V FLOW SUMMARY

SHEET OF

UPSTREAM FROM LAST REFERENCE NUMBER						RESIDUAL PLANT INJECTIONS					ACCUMULATED FLOW IN STREAMS				MAXIMUM ALLOWABLE FLOW @ 1.8fps	MINIMUM FLOW	2020 WET FLOW INCREMENT	2020 ACUM WET FLOW (MAX FLOW)
0		2 0 2 0									1 9 9 0		2 0 2 0					
WINTER MGD 11	REFERENCE NUMBER 12	SUMMER MGD 13	REFERENCE NUMBER 14	WINTER MGD 15	REFERENCE NUMBER 16	1990 MGD 17		2020 MGD 18		PLANT NUMBER 19	SUMMER MGD 20	WINTER MGD 21	SUMMER MGD 22	WINTER MGD 23	24	25	26	27
						S	W	S	W									
											[illegible]	[illegible]	124.3	[illegible]	235.0	[illegible]	—	—
[illegible]	3334	[illegible]	3334	45.3	3334	45.8	0	122	27.7		261.3	45.3	333.6	76.3	340.0	5.0	—	—
—	—	—	—	—	—	—	—	—		—	5.7	5.7	5.7	5.7	38.0	2.0	—	—
—	—	—	—	—				—		—	5.7	3.6	5.7	3.6	24.0	2.0	—	—
66.4	—	357.4	—	[illegible]	—	45.5	[illegible]	[illegible]	41.5	2.4	[illegible]	115.4	500.0 (-150)	115.2	500.0	20.0	—	—
—	—	—	—	—	—			—	—	—	.4	3.4	.8	3.4	23.0	2.0	—	—
—	—	—	—			—	—	—	—	—	3.8	5.0	8.6	5.0	15.0	3.0	—	—
—	—	—	—	—	—	—	—	—	—	—	[illegible]	11.8	[illegible]	1.8	23.0	2.0	—	—
—	—	—	—		—	—					20.4	11.8	17.0	1.8	23.0	2.0	—	—
28.6	—	41.0	—	28.6	—	—		—			44.8	28.6	141.0	28.6	210.0	3.0		—
—	—	—	—	—	—	—	—		—	—	12.4	10.4	10.4	10.4	69.0	2.0	—	—
10.4	11	10.4	11	10.4	11	[illegible]	[illegible]	[illegible]	[illegible]	3.5	154.2	40.8	29.8	59.7	223.0	12.0	—	—
—	—	—		—	—	—	—	—	—	—	6.3	6.3	6.3	6.3	42.0	2.0	—	—
—	—	—	—	—		—	—	—	—	—	6.3	6.3	6.3	6.3	25.0	3.0	—	—
6.3	14	6.3	14	6.3	14	—	—	—	—	—	22.3	26.4	27.6	26.4	[illegible]	7.0	—	—
26.4	15	27.6	15	26.4	15	[illegible]	[illegible]	[illegible]	34.2	7	42.2	35.7	184.9	67.6	165.0	5.0	—	—
—	—	—	—	—	—	—	—	—	—	—	7.7	7.7	7.7	7.7	41.0	3.0	—	—
7.7	17	7.7	17	7.7	17	—	—	—	—	—	29.7	7.7	16.8	7.7	109.0	7.0	—	—
7.7	18	16.8	18	7.7	18	127	[illegible]	[illegible]	[illegible]	6	144.1	74.9	200.9	117.5	230.0	9.0	—	—
—	—	—	—	—	—	—	—	—	—	—	7.4	7.4	7.4	7.4	49.0	4.0	—	—
[illegible]	—	383.2	—	192.5	—	—	—	—	—	—	376.6	118.0	425.2	192.5	410.0	22.0	—	—
—	—	—	—	—	—	—	—	—	—	—	8.7	5.1	5.1	5.1	34.0	2.0	—	—

Figure DA-V-B-4 ALTERNATIVE V FLOW SUMMARY

REFERENCE NUMBER	RURAL CONTRIBUTION 1990		RURAL FLOW DECREASE 1990 TO 2020 MGD	NAVAGATIONAL AND/OR RECREATIONAL TRANSFERS (1990 ONLY)		TRANSFER FLOW SOURCE (1990)		FLOW UPSTREAM FROM LAST REFERENCE NUMBER								RESIDUAL P…	
								1 9 9 0				2 0 2 0				INJECTIO…	
1	SUMMER MGD 2	WINTER MGD 3	4	SUMMER MGD 5	WINTER MGD 6	PLANT NUMBER 7	PLANT FLOW 8	SUMMER MGD 9	REFERENCE NUMBER 10	WINTER MGD 11	REFERENCE NUMBER 12	SUMMER MGD 13	REFERENCE NUMBER 14	WINTER MGD 15	REFERENCE NUMBER 16	1990 MGD 17	2020 MGD 18
																S.M. W.N.	S.M. W.N.
45	0	0	0	35.0	35.0	NORTH BRANCH TRANSFER		—	—	—	—	—	—	—	—	— —	— —
46	159.0	0	38.8	—	—	—	—	211.7	29 30 31 32	98.7	—	201.5	—	98.7	—	[illegible]	[illegible]
47A	0	0	0	20.0	20.0	15	20.0	—	—	—	—	—	—	—	—	— —	— —
47B	0	0	0	20.0	20.0	15	20.0	—	—	—	—	—	—	—	—	— —	— —
48	14.5	0	3.0	—	—	—	—	10.0	44	10.0	44	10.0	44	10.0	44	56.8 56.8	72.6 72.6
49	0	0	0	—	—	—	—	586.2	5 6 12 13	167.9	—	733.9	—	245.6	—	— —	— —
50	46.7	0	18.3	—	—	—	—	7.4 43.5 24.2 — 75.0 20.0 210.1	23 24 25 26 27 42 47B	132.0	—	236.2	—	152.1	—	[illegible]	[illegible]
51	18.1	0	6.9	+25	—	DU PAGE TRANSFER		749.5 1406.1 2155.6	50 53	624.7 965.6 1590.3	—	747.9 1560.0 2307.9	—	635.4 992.1 1627.5	—	[illegible] 0	[illegible] 0
52	177.2	0	44.5	—	—	—	—	376.6 25.1 5.0 11.3 486.2 2471.7 3375.9	21 28 37 38 49 51	118.0 11.3 5.0 6.3 167.9 1615.3 1923.8	—	425.2 19.5 5.0 11.3 633.9 2817.1 3912.0	—	[illegible] 11.3 5.0 6.3 249.6 1652.5 2117.2	—	15.1 0	19.3 0
53	0	0	0	100.0	—	DU PAGE TRANSFER		166.8 + 31.7 198.5	10 41	48.6 + 13.4 62.0	—	161.0 + 31.7 192.7	—	48.6 + 13.4 62.0	—	[illegible]	[illegible]

V-B-4 ALTERNATIVE V FLOW SUMMARY

SHEET OF 3

	TREAM FROM LAST REFERENCE NUMBER					RESIDUAL PLANT					ACCUMULATED FLOW IN STREAMS				MAXIMUM ALLOWABLE FLOW @ 1.8fps	MINIMUM FLOW	2020 WET FLOW INCREMENT	2020 ACUM WET FLOW (MAX FLOW)
0		2 0 2 0				INJECTIONS					1 9 9 0		2 0 2 0					
R	REFERENCE NUMBER 12	SUMMER MGD 13	REFERENCE NUMBER 14	WINTER MGD 15	REFERENCE NUMBER 16	1990 MGD 17		2020 MGD 18		PLANT NUMBER 19	SUMMER MGD 20	WINTER MGD 21	SUMMER MGD 22	WINTER MGD 23	24	25	26	27
						S.M	W.M	S.M	W.M									
	—	—	—	—	—		—	—	—		35.0	35.0	35.0	35.0	—	—	—	—
7	—	201.5	—	98.7	—	48.5	20.0	152.7	20.0	15	429.2	118.7	473.4	118.7	—	—	—	—
	—	—	—	—	—	—	—	—			20.0	20.0	20.0	20.0	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	20.0	20.0	20.0	20.0	—	8.0	—	—
0	44	10.0	44	10.0	44	50.8	50.8	72.6	72.6	14	75.3	60.8	94.1	82.6	—	8.0	41.2	135.3
6	—	733.9	—	249.6	—	—	—	—	—	—	586.2 -100.0 486.2	167.9	733.9 -100.0 633.9	249.6	—	—	—	—
0	—	236.2	—	152.1	—	301.5 191.2 492.7	301.5 191.2 492.7	342.0 116.3 458.3	342.0 116.3 458.3	7 13	745.5	624.7	747.9	635.4	—	—	265.7	1013.6
7 6 3	—	747.9 1560.0 2307.9	—	635.4 992.1 1627.5	—	2735	0	4750	0	OVERFLOW	2471.7	1615.3	2817.1	1652.5	—	—	—	—
0 3 0 3 9 3 8	—	426.2 19.5 5.0 11.3 633.9 2817.1 3912.0	—	192.5 11.3 5.0 6.3 249.6 1652.5 2117.2	—	15.1	0	19.3	0	10	3568.2	1923.8	4064.0	2117.2	—	—	—	—
6 4 0	—	161.0 +31.7 192.7	—	48.6 +13.4 62.0	—	[illegible]	[illegible]	[illegible]	[illegible]	3 4	1406.1	965.6	1560.0	992.1	—	—	412.9	1972.9

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